



Hydropower in the CDM:

Examining Additionality and Criteria for Sustainability

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TABLE OF CONTENTS

Executive Summary	2
1 Introduction	1
2 About Hydropower and CDM Hydropower Projects	2
2.1 Size classifications	3
2.2 Run-of-river versus reservoir hydropower plants	4
2.3 Hydropower in the CDM.....	5
3 Evaluating the additionality of hydropower CDM projects	7
3.1 Is financial return a good predictor of hydropower development?	8
3.2 Is the investment analysis accurate and verifiable for hydropower projects?	13
3.3 When should hydropower be considered common practice?	16
3.4 Discussion	18
4 Social and Environmental Impacts of Hydropower	18
4.1 Environmental impacts.....	18
4.2 Social impacts	21
4.3 Conclusion.....	23
5 Assessing the European Union’s Screening Criteria for Hydropower	25
5.1 World Commission on Dams criteria.....	25
5.2 The European Union’s WCD criteria to assess CDM hydro projects.....	26
5.3 Discussion of the EU WCD evaluation requirements.....	29
6 Conclusions	33

Executive Summary

Hydropower makes up 16% of installed electricity capacity worldwide and is in many cases already cost competitive and/or strongly supported by government policies. Hydropower makes up 30% of all carbon offsets projects registered under the Kyoto Protocol's Clean Development Mechanism (CDM) – just over 1000 projects as of 1 September 2011, the most of any project type. Hydropower also often has negative and sometimes severe impacts on river ecosystems and communities, including displacement of communities, loss of agricultural land, and decline in biodiversity. This means that effective criteria to ensure that accepted CDM hydropower projects generate new and additional emissions reductions and do not cause substantial social and environmental harm is critical. Otherwise, allowing hydropower to participate in the CDM risks generating large numbers of credits from business-as-usual projects that do not represent real emissions reductions, and risks transferring costs of climate change mitigation from polluters in the North to poor communities in the South.

This paper examines means for filtering CDM projects that have high likelihoods of generating real and new (additional) emissions reductions, and of avoiding substantial adverse social and environmental impacts. We focus the additionality analysis on China and India with a combined 78% of registered hydropower CDM projects, and on the Least Developed Countries (LDCs) which are the only host countries from which the European Union (EU) will accept CDM carbon credits for projects registered post-2012. We also evaluate the EU's assessment of compliance with World Commission on Dams (WCD) guidelines, a requirement for all large hydropower projects that wish to sell carbon credits into the European Emissions Trading Scheme.

ADDITIONALITY

The CDM requires each approved project to be 'additional': that it only went forward because of the extra financial support provided by the sale of carbon credits and would not have gone forward otherwise. Assuring that each project is additional is integral to the integrity of the CDM. Each business-as-usual project that is allowed to register under the CDM allows an industrialized country to emit more than their targets without causing the equivalent emissions to be reduced in a developing country.

Most large and small hydropower project proponents use the *Additionality Tool's investment analysis* to prove additionality, generally viewed as having the most potential to be accurate if performed well. The investment analysis is used to show that a project is not financially viable without additional funding available through the sale of carbon credits. The CDM's *Additionality Tool* also requires a common practice assessment as a credibility check; if a technology type is common practice, the proposed CDM project is not eligible for CDM crediting unless it can be shown to be "essentially distinct" from other similar projects in the same region.

Our analysis of factors that influence hydropower development decisions suggest the following conclusions:

Large hydropower should be excluded from the CDM in all countries because it is common practice, unlikely to be additional and additionality testing is inaccurate.

Large hydropower is a conventional technology that is being built in large quantities worldwide without carbon credits and should be considered common practice. China and India, the two countries with most hydropower CDM projects, have aggressive targets for building out their hydropower resources in attempts to meet soaring power demand and to address energy security concerns related to growing dependence in both countries on imported coal.

Furthermore, additionality testing is inherently inaccurate for large hydropower. First, financial return is not a good predictor of whether a large hydropower project will be built because non-financial factors have a large influence on decisions to develop these projects. In China, India, the LDCs and other countries, the government plays a dominant role in deciding how much and which hydropower projects are built; additionality testing is not meant to predict the planning processes of governments that take into account many factors other than those directly related to cost. The interest in building large hydropower in China, India and other countries supersedes the relatively small effect CDM carbon credits have on hydropower project financial return. Second, uncertainty in investment analysis inputs – particularly in the viability benchmark, expected capital costs, and cost and production risk – allows project developers to choose input values strategically in order to show that their projects are less financially viable than they really are.

Small hydropower projects should only be allowed under the CDM where they are not already being built or are being built at much slower rates than they would with carbon credits, and in countries in which the governments are less able to financially support the technology. Small hydropower typically benefits from less political backing than large hydropower and so is more likely to involve private developers, making financial return more predictive of the development decision. However, the investment analysis is unreliable for small hydropower projects for the same reason it is unreliable for large hydropower – uncertainty in input values. Small hydropower is already being built in some countries at substantial rates and therefore would not pass the common practice test in those areas. In countries where there already is development of small hydropower projects, such as in China and India with supportive subsidies and tariffs, allowing small hydropower projects to register under the CDM means potentially allowing a substantial portion of non-additional projects to register. Instead, types of small hydropower, defined by their size, location, and perhaps other objective characteristics, should be used to identify projects that are not currently being built, but which could be effectively enabled by the help of carbon credits. The effects of the CDM should be evaluated over time and should be clearly discernible for project types to continue to be eligible for crediting.

The common practice assessment should be strengthened. Our assessment of how the common practice test is being applied to hydropower projects shows that the definition of what constitutes common practice needs to be more stringent. At present, by allowing the boundaries of the assessment to be defined narrowly, and “essentially distinct” to be defined broadly, practically any project can be shown to not be common practice. Projects under construction and projects in the CDM pipeline should be included in the common practice assessment for technologies such as hydropower that are already being built without the CDM. If a technology is deemed to be common practice through the common practice assessment, a proposed CDM

project of that technology type should also be considered common practice; the ability to argue that a project is “essentially distinct” from other similar projects can easily be abused and should therefore be removed as an option under the common practice test.

SUSTAINABILITY CRITERIA

Hydropower projects can have negative and sometimes severe impacts on river ecosystems and communities, including displacement of communities, loss of agricultural land, and decline in biodiversity. The World Commission on Dams (WCD), established in 1998 in response to growing public scrutiny of large dams, developed a comprehensive framework for energy and water planning to ensure that adverse impacts from dam projects are minimized and the benefits and costs are more evenly distributed among stakeholders. The report is considered the most comprehensive, independent and thorough review of large dams to date.

To address concerns that hydropower projects can have serious environmental and social impacts the EU requires all credits from CDM hydropower projects larger than 20 Megawatts (MW) sold in the EU Emissions Trading Scheme to meet World Commission on Dams environmental and social standards, but similar standards are not required by the CDM itself.

Shortcomings in the EU’s assessment of WCD compliance

While the EU took a laudable step to operationalize the WCD guidelines, the current rules in many instances do not go far enough. Below we outline the shortcomings we find in the EU’s assessment of WCD compliance.

Inherent conflicts of interest in WCD compliance evaluations. The WCD requires that projects be appraised by auditors that are institutionally and financially independent from the project developers. The EU guidelines require that the project developer hire and pay a Designated Operational Entity (DOE) to conduct the assessment. An inherent conflict of interest exists when those performing or verifying project assessments are hired directly by those with vested interests in the projects going forward. In our interviews and e-mail exchanges with European DNAs, we did not find a single instance where a project was rejected by a DNA because of an insufficient WCD evaluation. We recommend:

- The Designated National Authority (DNA) of the buyer country, or another government agency, rather than the project developer, should choose WCD auditors. Project developers should be charged a fee that covers the costs of those audits and the oversight tasks of the government agency.
- The quality of WCD verification reports should be reviewed carefully. Future auditor hiring decisions should be based on whether previous assessments were performed rigorously and conservatively.
- Auditor performance should be evaluated periodically during a process of re-accreditation.
- The accreditation and re-accreditation processes should involve conflict of interest assessments.

Weak guidelines for and evaluation of stakeholder involvement. The WCD emphasizes that throughout project planning and implementation project-affected people must have the opportunity to actively participate in the decision-making process. Where projects affect indigenous and tribal peoples, decision-making processes must be ‘guided by their free, prior

and informed consent'. But the EU guidelines do not require mutual agreement of key issues such as compensation packages with all recognized adversely affected people; they had merely to be planned 'in consultation' with affected people. Furthermore, the proof of 'free, prior and informed consent' from indigenous or tribal peoples is not required. We recommend:

- Auditors should receive additional guidelines and requirements on how to assess stakeholder involvement. These could be modeled and expanded based on Gold Standard processes and requirements.
- The EU should require formal agreements regarding compensation and rehabilitation plans and the distribution of benefits from the dam between the project developer and project-affected persons in order to demonstrate acceptance of key decisions.
- The EU should require the proof of free, prior and informed consent of indigenous people.

Uneven access to compliance reports. Member States are required to provide publicly accessible information on projects that have been approved. We found that Member States interpret this requirement quite differently. While some, such as Germany, make all the WCD compliance reports available on their website,¹ others such as Sweden, France, the UK, Spain and the Netherlands do not. We recommend:

- EU member states should be required to provide online access to compliance reports and other relevant project information.

Only large hydropower projects must comply with WCD guidelines. Categorizing hydropower by size is somewhat arbitrary, as there are no clear relationships between installed capacity and general properties of hydropower (Kumar et al. 2011) or impacts (Kibler 2011). Furthermore smaller projects are subjected to fewer regulations and scrutiny in India and China, which represent over 70% of all small hydropower projects in the CDM pipeline (CDM/UNEP Risoe 1. Sept. 2011) and is likely to be the case for other countries as well. We recommend:

- All hydropower projects, large and small, should be required to meet WCD criteria.

CONCLUSION

Over 1000 hydropower projects are already registered under the CDM and another 700 are applying for registration. The consequences of registering non-additional projects and those with substantial adverse environmental and social impacts undermine climate mitigation goals by actually increasing emissions and placing the costs of climate change mitigation on those communities that most vulnerable to the impacts of climate change. Excluding large and some small hydropower projects from the CDM and strengthening WCD compliance evaluations are important steps the European Union could take to strengthen the integrity of its climate change mitigation goals.

¹ <https://www.jicdm.dehst.de/promechg/pages/project1.aspx>

Hydropower in the CDM: Examining Additionality and Criteria for Sustainability

Barbara Haya² and Payal Parekh³

Abstract

This paper examines the effectiveness of additionality and sustainability criteria being applied to hydropower projects applying for carbon crediting under the Kyoto Protocol's Clean Development Mechanism (CDM). We examine the conditions under which hydropower development decisions are commonly made, with a focus on China and India where the majority of CDM hydropower projects are hosted. We find that the CDM is having little effect on large hydropower development, and that the basic conditions needed for an accurate additionality assessment are not met. In particular, non-financial factors such as energy security heavily influence decisions to build large hydropower, and uncertainty in investment analysis inputs allows project developers to choose input values strategically in order to show that their projects are less financially viable than they actually are. Further, large hydropower and some small hydropower are being built in large quantities worldwide, are heavily supported by governments, and therefore should be considered common practice and ineligible for CDM crediting. We recommend that large hydropower be excluded from the CDM, and that small hydropower be accepted only in places where it is not already being built. The second part of this paper examines the European Union's (EU's) assessment of compliance of hydropower projects with World Commission on Dams (WCD) guidelines. We identify several shortcomings including auditor conflicts of interest, weak guidance for the assessment of public consultations, lack of documented acceptance of projects by project-affected persons, and insufficient access to compliance reports by the general public. We provide concrete recommendations to strengthen the EU's assessment of WCD compliance.

1 INTRODUCTION

The Kyoto Protocol's Clean Development Mechanism (CDM) allows industrialized countries (Annex 1) to partially meet their Kyoto Protocol commitments by reducing emissions in developing countries (non-Annex 1) and using the resulting emissions reduction credits towards their Kyoto targets. The CDM plays a pivotal role in the international climate change regime helping emitters in industrialized countries lower their costs of compliance and providing funds for renewable energy, energy efficiency and other emissions reducing activities in developing countries. An appeal of the CDM is efficiency – the CDM is designed to create a more global market for emissions reductions, allowing regulated emitters to reduce emissions wherever in the world it is least expensive to do so. However, critics of the CDM have

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challenged the program's efficiency claims, arguing that large numbers of CDM projects are generating credits that do not represent real additional emissions reductions (He & Morse 2010, Lazarus & Chandler 2011, Michaelowa & Purohit 2007, Schneider 2009, Wara & Victor 2008) and do not contribute to sustainable development (Boyd et al. 2009, Schneider 2007).

Hydropower makes up 16% of installed electricity capacity worldwide and is in many cases already cost competitive and/or strongly supported by government policies (Kumar et al. 2011). Hydropower makes up 30% of all registered CDM projects, just over 1000 projects (CDM/UNEP Risoe 1. Sept. 2011), the most of any project type. This means that the criteria applied to proposed CDM projects to ensure that accepted projects generate new and additional emissions reductions must be accurate and effective. If they are not, allowing hydropower to participate in the CDM risks generating large numbers of credits from business-as-usual development of a conventional technology.

In addition, hydropower projects can have negative and sometimes severe impacts on river ecosystems and communities, including displacement of communities, loss of agricultural land, and decline in biodiversity. To address this, the European Union (EU) requires all credits from CDM hydropower projects sold in the EU Emissions Trading Scheme (EU-ETS) to meet World Commission on Dams (WCD) environmental and social standards, but similar standards are not required by the CDM itself.

The analysis in this paper centers around a practical policy question – how to ensure that CDM credits from hydropower projects have a high likelihood of being additional and of avoiding substantial adverse social and environmental impacts? We focus the additionality analysis on China and India with a combined 78% of registered hydropower CDM projects (CDM/UNEP Risoe 1. Sept. 2011), and on the Least Developed Countries (LDCs) which are the only host countries from which the EU will accept CDM carbon credits (Certified Emissions Reductions – CERs) for projects registered post-2012. We focus the assessment of sustainability criteria on the World Commission on Dams guidelines and the EU's assessment of WCD compliance.

Section 2 provides background information on different types of hydropower and a summary of the hydropower projects in the CDM. Section 3 examines the additionality of large and small hydropower projects, and the accuracy of additionality testing in the case of hydropower. Section 4 describes the common social and environmental impacts of hydropower projects of different sizes and types. Section 5 discusses World Commission on Dams (WCD) guidelines created to minimize adverse impacts from dams and the EU's assessment of WCD compliance. Section 6 presents our conclusions and recommendations.

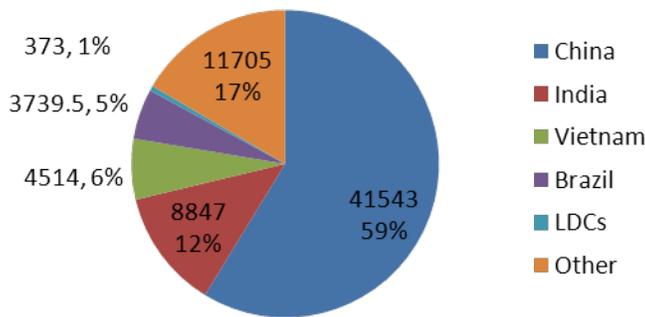
2 ABOUT HYDROPOWER AND CDM HYDROPOWER PROJECTS

There are over 37,000 large dams listed in the World Register of Dams, a database maintained by the International Commission on Large Dams (ICOLD), which defines a large dam as one with a height of at least 15 m from the foundation. No reliable data exist for the number of small dams worldwide (Anisfield 2010). Dams are built primarily for irrigation purposes. Hydropower, domestic and industrial use, and flood control (in descending order of use) are the other main reasons for building dams. During the 1990s, the majority of financial investments in dams were for hydropower projects (WCD 2000).

Currently hydropower is the largest source of non-fossil fuel electricity globally. In 2008 hydropower accounted for 16% of electricity supply worldwide with an installed capacity of 926 Gigawatts (GW), producing 3,551 billion kilowatt hours per year (Kumar et al 2011). Its growth is expected to continue in part due to its low carbon emissions.

China, Brazil and India are the 1st, 2nd and 6th largest hydroelectricity producer countries with installed capacities of 200, 84 and 38 GW, respectively (IJHD 2010). Hydropower constitutes 15.5 and 17.5% of the domestic grid in China and India, while it accounts for 84% of Brazil’s domestic electricity production (IJHD 2010). We highlight these three countries, because they represent over 75% of the hydropower projects in the CDM pipeline (Figure 1).

Figure 1: Total Installed Capacity (MW) in CDM Pipeline by Country



(Source: CDM/UNEP Risoe 1. Sept. 2011).

2.1 SIZE CLASSIFICATIONS

While dams of all purposes are usually classified as large or small based on dam wall height, hydropower dams are usually classified by installed capacity (megawatts - MW). Hydropower dams can vary tremendously in size. In the CDM for example, the smallest project is 0.1 MW (Bhutan) whereas the largest is 1200 MW (Brazil). There is no consensus for setting the size threshold (Egré and Milewski 2002). For example, Sweden classifies a hydropower plant as large if its installed capacity exceeds 1.5 MW (European Small Hydro Association 2010), while in Canada and China the cut-off is 50 MW (Natural Resources Canada 2009, Ministry of Water Resources – China 2002). Defining hydropower by size is somewhat arbitrary, as there are no clear relationships between installed capacity and general properties of hydropower (Kumar et al. 2011) or impacts (Kibler 2011). This is because hydropower is site specific (Kumar et al 2011, McCully 2001) and definitions of categories by government agencies are chosen to match local energy and resource management needs (Kumar et al 2011).

The CDM considers all renewable energy including hydropower projects with an output capacity up to 15 MW (or appropriate equivalent) small (Decision 17/CP.7, paragraph 6(c)). The EU Linking Directive on the other hand, considers hydropower with an installed capacity greater than 20 MW large (Directive 2004/101/EC, article 11a (6)).

2.2 RUN-OF-RIVER VERSUS RESERVOIR HYDROPOWER PLANTS

The two main types of hydropower are run-of-river (RoR) and reservoir (Figure 2 and Figure 3). Depending on the hydrology and topography of the watershed, both types can be large or small (Kumar et al 2011).

A reservoir hydropower plant stores water behind a dam for times when river flow is low, resulting in power generation that is more stable and less variable than RoR plants (Figure 3). Often the reservoir is an artificial lake located in an inundated river valley. In mountainous regions, existing high latitude lakes are sometimes turned into (larger) reservoirs. Reservoir hydropower plants can have major environmental and social impacts due to the flooding of land for the reservoir.

Figure 2: Schematic diagram of a Run-of-River hydropower plant

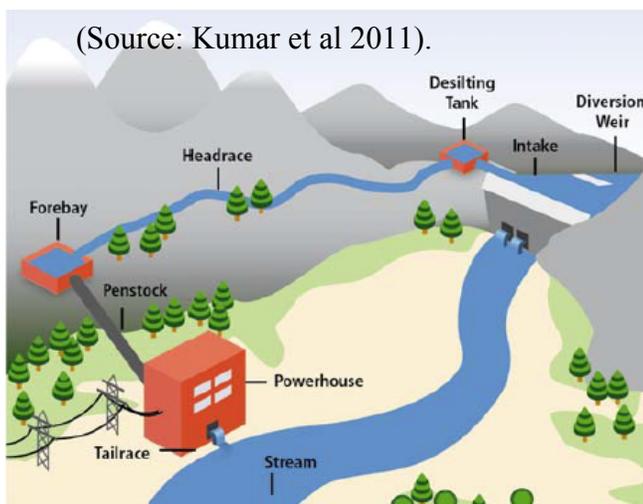
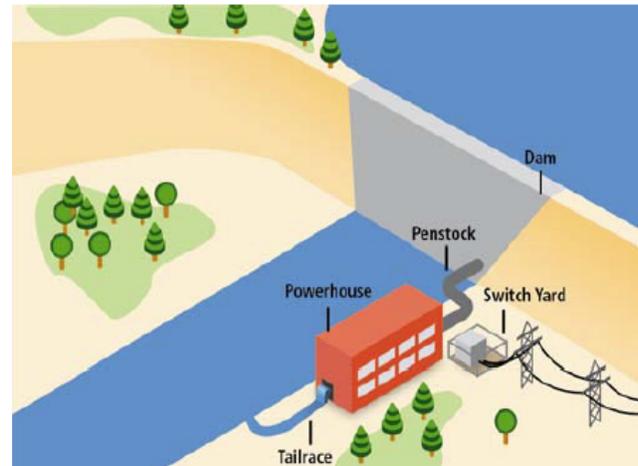


Figure 3: Schematic diagram of a reservoir hydropower plant

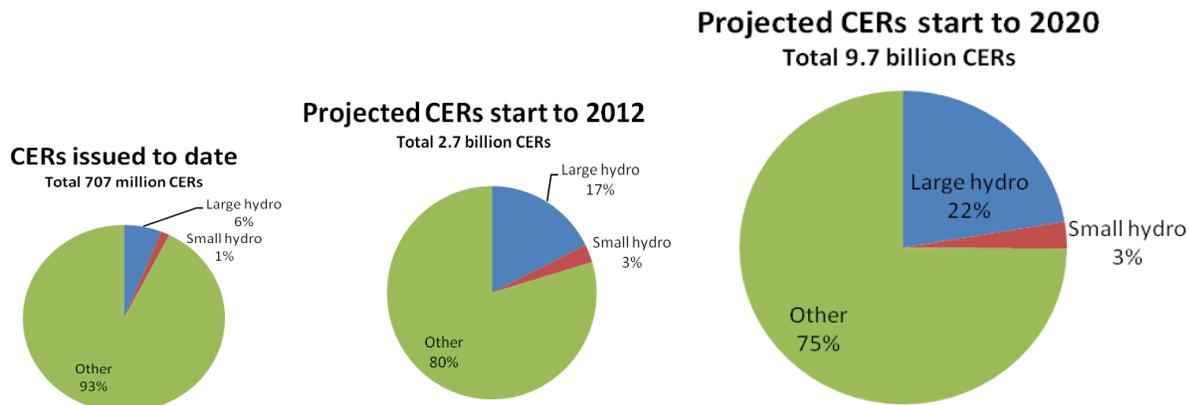


A RoR plant primarily draws energy from the available flow of the river (Kumar et al 2011), taking advantage of the natural elevation drop of a river. Therefore it is suitable for streams or rivers that have a minimum flow all year round or those that are regulated by a larger dam and reservoir upstream (Raghunath 2009). Water is diverted into a penstock or pipe and channeled to the turbine and then returned to the river (Figure 2). The elevation difference between the intake and the powerhouse provides the kinetic energy needed to power the turbine and produce electricity. The longer the diversion, the higher the environmental impacts can be. Power generation tends to be variable at RoR plants, depending on the extent of storage and the natural fluctuations in seasonal flow (Kumar et al 2011). RoR plants have either no storage or short-term storage; such reservoirs are usually smaller than those of reservoir hydro power plants. Yet RoR reservoirs can be quite large and there is no maximum size specified for RoR reservoirs above which they would be considered a reservoir hydro power plant. RoR dams can be ten to twenty meters high and can have gates to allow for water storage (McCully 2001). Impacts of RoR and reservoir hydropower plants are discussed in more detail in Section 4.

2.3 HYDROPOWER IN THE CDM

Hydropower is the most prevalent project type in the CDM pipeline (under validation and registered) comprising 26% of all projects. Hydropower accounts for 7% of CERs issued to date; it is expected to generate 20% of all CERs by 2012 and 25% by 2020 (CDM/UNEP Risoe August 1st 2011, see Figure 4). Hydro projects can register under the CDM either as small scale projects (<15 MW) or as large scale projects (>15 MW).⁴ While there are more small hydro projects (≤ 15 MW) in the CDM pipeline, larger projects account for over 80% of CERs from hydropower generated by 2012 and for over 85 % in 2020 (Figure 4; CDM/UNEP Risoe 1. August 2011).

Figure 4: Percentage of CERs from large and small hydropower in 2011, 2012 and 2020



Although hydropower is the most prevalent project type in the CDM, they are located in a small number of countries. Almost 90% of all hydro projects in the CDM pipeline are located in China, India, Vietnam and Brazil, countries considered emerging economies. Three of the four countries (China, India, and Brazil) are ranked within the top ten hydroelectric producing countries globally (IJHD 2010). China is expected to generate the most credits from small and large hydro (Figure 5, Figure 6, Figure 7, Figure 8). In contrast, less than 1% of registered projects are hosted in Least Developed Countries (LDCs).

⁴ Large hydro projects primarily (99%) use methodology ACM0024, which was developed for grid-connected electricity generation from renewable sources. All small hydro projects use the AMS-I.D.4 methodology, which was developed for grid-connected renewable electricity generation for small projects. Some small scale projects use AMS-I.A.4 or AMS-I.F.4 in conjunction with AMS-I.D, which account for electricity generation by the user; and captive use and mini-grid, respectively.

Figure 5:

Number of Registered Small Hydro (15 MW or less) by Country

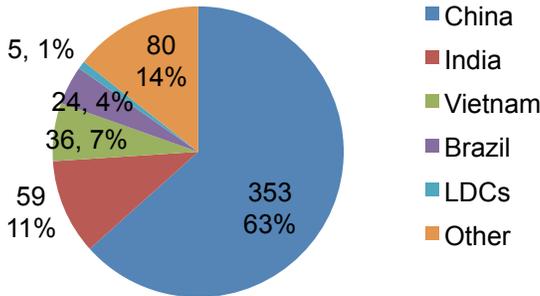


Figure 6:

Number of Registered Large Hydro Projects (> 15 MW) by Country

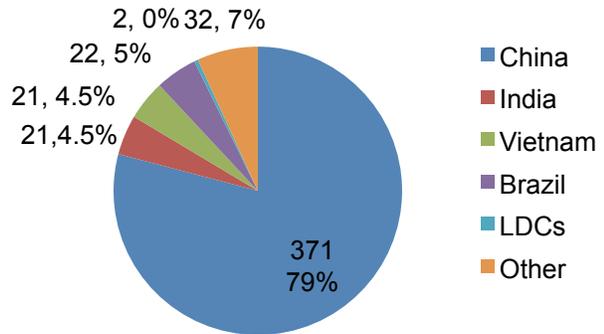


Figure 7:

Small Hydro Projects (15 MW or less) in the CDM Pipeline by Country

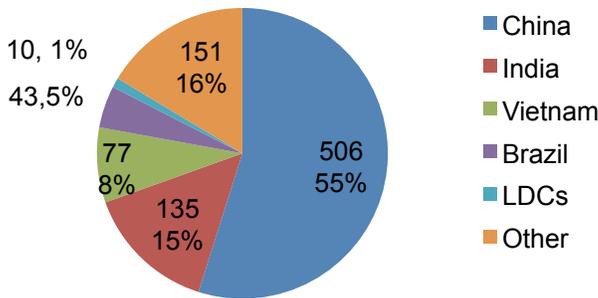
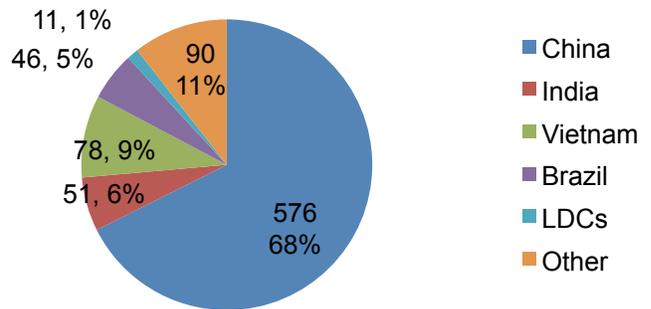


Figure 8:

Large Hydro Projects (> 15 MW) in CDM Pipeline by Country



(Source: CDM/UNEP Risoe 1. Sept. 2011; Rejected and Withdrawn projects are not included).

3 EVALUATING THE ADDITIONALITY OF HYDROPOWER CDM PROJECTS

The CDM requires that a project prove that it is ‘additional’: that it only went forward because of the extra financial support provided by the sale of carbon credits and would not have gone forward otherwise. Assuring that each project is additional is integral to the integrity of the CDM. Each business-as-usual project that is allowed to register under the CDM allows an industrialized country to emit more than their targets without causing the equivalent emissions to be reduced in a developing country. Verifying that an activity is additional is difficult because it involves assessing the considerations of a project developer under a counterfactual scenario in which there was no CDM.

The “Tool for the demonstration and assessment of additionality,”⁵ is the most common method used for proving the additionality of proposed CDM projects. The *Additionality Tool* has three basic steps. The project proponent must:

- identify alternatives to the project activity.
- conduct an investment analysis and/or a barrier analysis to prove the project would not otherwise proceed.
 - The investment analysis demonstrates that a project is not financially attractive without CER revenues.
 - The barrier analysis documents barriers that would prevent the project from going forward without the additional support from CER sales.
- undertake a common practice analysis as a “credibility check” to filter out project activities that are already commonly implemented.

In order to probe whether additionality testing is able to effectively filter out non-additional hydropower projects if performed more rigorously, we examine whether the conditions under which hydropower development decisions are being made are conducive for additionality testing.

Most large and small hydropower project proponents use the investment analysis to prove additionality, either alone or in combination with the barrier analysis. Most attention placed on improving project-by-project additionality testing focuses on improving the accuracy of the investment analysis, viewed as having the most potential to be accurate if performed well.

Two conditions are necessary for the investment analysis to be accurate: (1) Financial return must be a good predictor of whether a project will be built. And (2) an investment analysis must accurately and verifiably reflect the real financial considerations of key project decision-makers. We explore whether these two conditions are true for hydropower, and then examine whether large and small hydropower meet the CDM’s requirement that projects not be common practice.

⁵ The *Tool for the demonstration and assessment of additionality*, and a version of this tool that is combined with a baseline identification methodology - *Combined tool to identify the baseline scenario and demonstrate additionality* - can be found here: <http://cdm.unfccc.int/methodologies/PAMethodologies/approved.html>

3.1 IS FINANCIAL RETURN A GOOD PREDICTOR OF HYDROPOWER DEVELOPMENT?

In this section, we examine how large hydropower development decisions are being made with a focus on China, India and the LDCs to assess whether financial return is a good predictor of hydropower development and the likely influence of the CDM on hydropower development decisions.

3.1.1 Large hydropower in China

China's *Middle and Long Term Development Plan for Renewable Energy* calls for a doubling of China's hydropower capacity from around 150 GW to 300 GW between 2007 and 2020 (NDRC 2007). This hydropower expansion, in the country that already has the world's largest hydropower capacity, is unprecedented in its scale. Much of this growth is expected to come from the large and largely untapped hydropower capacity in the southwest of the country.⁶ Plans include a series of large back-to-back reservoirs along western rivers such as the Lancang and the Nu as a part of China's Great Western Development campaign. Much of the electricity from these dams will be brought to meet electricity demand in population and industrial centers in China's east (Magee & McDonald 2009).

China is heavily promoting hydropower and renewable energy as a way to decrease its reliance on coal. The high proportion of coal on China's grid (78% in 2009) is of concern because of increasing coal prices, growing reliance on imports and air quality impacts (Kahrl et al 2011). China has identified hydropower as the most important replacement of coal in terms of its percentage of power on the grid (ibid). There is also strong interest in hydropower development at the provincial and local government levels because of its potential to support local economic growth (ibid) and to ensure adequate electricity supply to attract industry.^{7 8}

Government in China plays a large role in determining how much and which hydropower is developed. The central government sets national goals for the sector as a whole, most importantly through its five-year plans. The government controls the amount of hydropower that is built by setting the tariffs for hydropower projects, which are set by China's National Development and Reform Commission (NDRC) on a project-by-project basis (Kahrl et al 2011). Despite steps China has taken towards introducing competition into its power sector through a series of reforms, the tariff-setting process maintains a top-down approach to carrying out policy objectives (ibid). The Chinese government also supports hydropower development by providing access to low-interest loans (Bogner & Schneider 2011).

Further, China's hydropower sector is predominantly state-owned. China's large hydropower development (defined in China as greater than 250 MW) is allocated to "the big five" – the five large state-owned companies that were created when China's monopoly state-

⁶ Shanghai Daily, (January 6, 2011). *China Ready for Flood of Hydropower*. (<http://business.globaltimes.cn/industries/2011-01/609534.html>, accessed 3 November 2011)

⁷ Interview with Kristen McDonald, on 9 October 2011

⁸ In the last five-year plan, China did not meet its goal for hydropower approvals, but this was due to tensions within the government between the Premier and the Ministry of Water on the one hand which rejected projects based on their expected environmental impacts, and the local governments and hydropower developers on the other which wish to build these projects (Magee & McDonald 2009), considerations that would not be influenced by the CDM. Hydropower in the CDM: Examining Additionality and Criteria for Sustainability 8

owned power company was broken up in 2002. Medium hydropower, defined as between 50 and 250 MW, is typically built by companies owned by some combination of subsidiaries of the big five, municipalities, and banks and private investors.⁹ These hydropower developers sell their power to the two state-owned grids, or less frequently to municipalities.¹⁰ Most banks in China are state-owned (Naughton 2007). Sinohydro, China's national hydropower developer, built around 65% of China's hydropower capacity.¹¹ State-owned enterprises in China generally do not lack capital resources or access to debt financing on good terms and receive various other forms of government support.¹²

Within this context, it seems highly unlikely that the CDM can lead to additional hydropower development in China. The government has a strong interest in supporting large scale hydropower development and has the means to effectively carry those goals forward. China's interest in building large hydropower supersedes the relatively small effect CERs have on hydropower project return. The investment analysis with its sole focus on financial return measured against a clear viability benchmark is not predictive of how large and medium hydropower development decisions are being made in China, given the range of consideration being made by government in China at all levels of decision-making.

3.1.2 Large hydropower in India

India is also expanding its power sector very quickly to meet soaring power demand and chronic power shortfalls. It anticipates quadrupling its electricity supply between 2005 and 2030, a tremendous undertaking. It intends to do so through pursuing all fuel options (Planning Commission of the Government of India 2006). India's Eleventh Five Year Plan called for 16.5 GW of hydropower to be built between 2007 and 2012 (Planning Commission of the Government of India 2008). The Central Electricity Authority recommends that 30 GW be pursued during the twelfth five year plan between 2012 and 2017 (Central Electricity Authority 2008).¹³

Hydropower is viewed as an attractive source of power because it is a domestic resource without the energy security concerns of coal and natural gas, a serious concern for India since it expects imports of coal and natural gas to increase in the future (Planning Commission of the Government of India 2006). Hydropower is also considered the best option for providing peak power (Planning Commission of the Government of India 2006).

In India, river development is determined through a government planning process involving a team of public and private actors. This planning process identifies potential large hydropower sites and determines which specific sites will be developed in what order and by which sector – central, state or private (Central Electricity Authority 2008). These plans follow India's five-year planning cycle. The private sector is involved in hydropower development by participating in the planning process, and by responding to bid requests put out by national- and state-owned power companies.

⁹ Interview with Kristen McDonald, on 9 October 2011

¹⁰ *ibid*

¹¹ <http://www.hydrochina.com.cn/English/pages/aboutus/brief.jsp>, accessed 17 October 2011

¹² Interview with Kristen McDonald, on 9 October 2011, and noted in a number of CDM application documents for hydropower projects in China that are built by privately owned hydropower developers.

¹³ With the expectation that 25 GW is feasibly attainable.

Additionality testing is not meant to predict the planning decisions of governments, which consider a wide range of factors in their planning process beyond those directly related to cost. In the case of Indian hydropower, the planning commission takes into account energy security concerns, displacement of people, the need for peak power, and the competing uses of rivers for irrigation and flood control, all concerns that are not easily monetized and integrated into an investment analysis with a reliable benchmark (Central Electricity Authority 2008).

The Indian government has mapped out its hydropower resources by river basin, ranking the attractiveness of potential hydropower sites (Central Electricity Authority 2008). This ranking contributes to the decision of which plants will be built in what order. When hydropower sites are mapped out and ranked for future development, the most influence the CDM might have on planning decisions is to accelerate the pace at which some hydropower facilities are being built, not whether they are built at all, perhaps justifying only a few years of credits for some projects if the acceleration effect is discernible. This would be true for many countries in addition to India and China that have assessed potential hydropower sites with the intention of expanding their hydropower capacity.

The effect of CDM revenues on India's planning process is not clearly apparent. Neither India's 11th Five Year Plan nor its 12th Hydropower Plan mention the CDM or carbon credits as a factor in its decisions to support and develop hydropower and renewable energy (Central Electricity Authority 2008, Planning Commission of the Government of India 2008: Chapter 10-Energy). The few times the CDM is mentioned, it is only mentioned to highlight India's contribution to global climate change mitigation efforts, rather than as a factor helping India develop its hydropower resources (Planning Commission of the Government of India 2006).

The CDM is also unlikely to have much influence on private sector involvement in hydropower development in India. The tariff paid to hydropower developers per kilowatt hour produced is calculated on a cost-plus basis for each hydropower facility and is adjusted periodically to ensure that the developer receives a pre-agreed return on equity based on their true costs and power output. This return on equity investment is typically 14% or 15.5%.¹⁴ This means that most project costs are "passed through," since they are returned to the developer through the tariff. Therefore hydropower developers take little of the risk that there will be cost overruns during construction, or that less power will be produced than expected. As a result, the financial return to a large hydropower developer varies only minimally between projects. When the tariff is determined on a cost-plus basis per project, a financial return analysis has little meaning, and is not an appropriate indicator of whether a project would be built. Since tariffs are set to guarantee each developer a pre-determined return on their equity investment, the investment analysis is not meaningful in distinguishing the feasibility of individual hydropower projects.

3.1.3 Hydropower in general, with a focus on the Least Developed Countries (LDCs)

¹⁴ 14% is the return on equity from the Central Electricity Commission's 2005 tariff order and 15.5% is the return on equity from the 2009 tariff order. The CERC order applies to all central plants, and plants whose electricity is traded between more than one state. Each state writes its own tariff policy for its own plants, typically modeled after the CERC policy.

Of the twelve hydropower projects above 10 MW in the CDM pipeline (both registered and in the validation stage) in LDC countries, all but two document direct government involvement in the project in their CDM application documents (project design documents – PDDs).¹⁵

As our description of hydropower decision-making in China and India show, decisions to build hydropower are complex and political, and involve a range of considerations beyond those directly influencing cost. Large hydropower is often treated in a similar manner to mining; rivers are an exploitable resource that the government can use as political currency, giving the right to build a facility to public and private entities.

Government involvement, including through international, bi-lateral lending agreements and loan guarantees, is also common with hydropower development due to its nature as an infrastructure project, large upfront capital requirements, and high levels of uncertainty and risk associated with its construction costs and electricity output. Lending decisions can be based on political rather than purely financial grounds. For example, Chinese banks provide loans to Chinese hydropower development in Africa often as a part of much larger agreements for trade and investment between itself and the African country (Bosshard 2008).

Almost half of all hydropower plants with dams greater than 15 meters in height worldwide are considered multipurpose.¹⁶ These dams can be used for irrigation, flood control and/or other services in addition to electricity generation. Quantifying the benefits of these other uses, such as by attributing a portion of project capital costs to these other purposes, is far from straightforward. Benefits from other project uses are not commonly quantified in investment analyses for CDM hydropower projects. This means that hydropower CDM projects that serve multiple purposes can appear to be less cost effective than they actually are if benefits from other uses are left out of the investment analysis or are given a low value.

The influence of non-financial factors in hydropower development decisions is evidenced by the fact that large hydropower projects are typically more costly than predicted, sometimes by more than double (World Commission on Dams 2000: chapter 2), yet decisions to build large hydropower projects are repeatedly approved by governments as well as international and bi-lateral finance institutions based on low cost estimates.

Certainly cost affects the decision to build a large hydropower project, but given the relatively small effect of CERs on project return and the range of influences on project development beyond cost factors, the effect of CERs is in the noise and is not predictive of project development.

3.1.4 *Small hydropower*

Small-scale hydropower facilities, with their smaller electricity output and financial requirements, typically draw less political interest, involve different decision-making processes

¹⁵ Six are built directly by government developers, one was built by private developers responding to requests for proposals from the government, and one project mentions a government loan guarantee. One was a part of a larger economic, cultural and technical science cooperative agreement between the governments of Lao and Vietnam, and another involved an agreement to sell electricity from the project in Myanmar into the Chinese grid.

¹⁶ International Commission on Large Dams (ICOLD), Register of Dams, General Synthesis (http://www.icold-cigb.org/GB/World_register/general_synthesis.asp, accessed 3 November 2011)

and government support, and are more likely to be initiated by private sector actors compared to large hydropower. In some countries, like India and China, small hydropower formally involves different tariff-setting and planning processes. With regard to additionality testing, small-scale hydropower shares some features of large hydropower and some emerging technologies like wind, depending on location and size.

Many of the factors that make large hydropower a political decision are less important with small hydropower, including the importance for meeting electricity demand, potential for corruption, scale of the financial risk, and involvement of international lending institutions.

Both India and China actively support the development of small hydropower, defined as less than 25 MW in India, and less than 50 MW in China. Already in 2009 China had 55 GW of hydropower capacity, the most in the world. China's 2007 Renewable Energy Plan defined a goal of expanding China's small hydropower capacity to 75 GW by 2020. China is promoting small hydropower with a combination of tax benefits and dedicated and low interest loans, technical training and preferential tariffs (Jiandong 2009). Instead of defining the tariff for each project individually as is done with large hydropower, provinces should define preferential tariffs that are paid to private developers that choose to build small hydropower projects. China has a strong interest in supporting small hydropower, considered the best means for extending electrification to 100% of households, a priority goal of the government (Jiandong 2009). About one-third of China's counties rely on small-scale hydropower as their main power generation source (International Energy Agency 2007).

India also has goals to provide full rural electrification (Planning Commission of the Government of India 2006); small hydropower is viewed as an important way to provide electricity access to remote areas.¹⁷ India's 12th five year plan includes a goal of increasing its small hydropower capacity from just under three GW at the beginning of 2011 to around six GW in 2017.¹⁸ The Government of India has instructed the states to set preferential tariffs for small hydropower tariffs (Central Electricity Regulatory Commission 2009) and offers financial incentives including capital subsidies (Ministry of New and Renewable Energy 2009).

In both India and China, the preferential tariffs set at the state and province level mean that any approved hydropower project will receive that tariff, regardless of its costs.¹⁹ In this context, as opposed to cost-plus tariff determinations for large hydropower in both countries, the CDM could improve the financial returns of a project and could potentially spur more development. Still, the challenges with assessing the additionality of small hydropower are not unlike those of large hydropower. By setting goals for small hydropower development, defining promotional tariffs, and creating incentives the Chinese and Indian governments are substantially affecting the amount of small hydropower built. He and Morse (2010) describe how, by setting the tariff for wind, the Chinese government in effect decides what wind projects are additional and not additional. The same argument applies to small hydropower in both India and China. If the government does not see enough small hydropower being built, it can raise the incentives, or

¹⁷ From the Government of India, Ministry of New and Renewable Resources web site, <http://www.mnre.gov.in/>, accessed 19 October 2011

¹⁸ *ibid*

¹⁹ In practice this is not always the case. Tariffs for many of the small hydropower projects registered under the CDM in both China and India are set in the same way as they are for large hydropower.

if it sees that small hydropower is being built quickly, it can lower its incentives and invest those funds elsewhere.

This discussion suggests that the CDM is more appropriate for small hydropower in countries where the government is investing fewer financial resources to incentivize the development of small hydropower and where small hydropower would not be considered common practice (discussed below in Section 3.3). Ensuring small hydropower projects accepted for crediting have high likelihoods of being additional will also depend on the accuracy of the investment analysis for this technology (discussed in the next section).

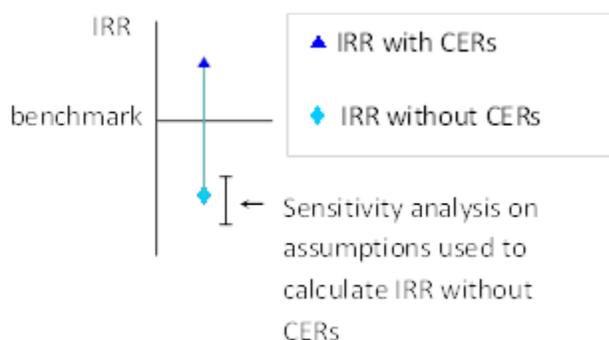
3.2 IS THE INVESTMENT ANALYSIS ACCURATE AND VERIFIABLE FOR HYDROPOWER PROJECTS?

In this section we assess the accuracy and verifiability of the inputs that go into the investment analysis. We first provide a more detailed description of the investment analysis, and then assess the level of uncertainty in two major investment analysis inputs – the benchmark and project capital costs.

3.2.1 The Additionality Tool’s investment analysis

The investment analysis is used to show that a project is not financially viable without carbon credits. A benchmark is determined that represents the threshold financial return, or hurdle rate, defining whether the project would likely go forward. For renewable energy and hydropower projects, the benchmark is most commonly defined in terms of project or equity internal rate of return (IRR).²⁰ If the expected financial return of the project is below the benchmark, then it is assumed that the project most likely would not have gone forward without carbon credits and the project is considered additional. The financial assessment is tested with a sensitivity analysis of the most important cost and revenue inputs. It is optional to show that CERs bring the financial return of the project above the benchmark. Figure 1 illustrates the investment analysis for a project that is additional and uses IRR as the metric used to assess project financial return.

Figure 9: The Investment Analysis



3.2.2 Examination of the benchmark

Hydropower developers have used all four options recommended by the CDM Executive Board in their latest guidance on the investment analysis²¹ to determine the viability benchmark in their CDM application document. These four options are: (1) Local commercial

²⁰ Internal rate of return (IRR) is the discount rate that would be applied to the cash flow of a project so that the net present value of the project is zero. A higher IRR indicates better financial return.

²¹ Executive Board Report 51, Annex 58, *Guidelines on the Assessment of the Investment Analysis (version 3)*, report from EB meeting ending 4 December 2009, http://cdm.unfccc.int/EB/051/eb51_repan58.pdf

lending rates (for project IRR), (2) weighted average cost of capital (WACC)²² (for project IRR), (3) required/expected return on equity (for equity IRR), and (4) benchmarks supplied by relevant national authorities if the validator can validate their applicability (for both project and equity IRR).²³ Chinese hydropower developers almost exclusively use the fourth option, benchmarks supplied by the government. In India, most use the second option – the weighted average cost of capital (WACC).

Calculation of WACC typically involves a combination of two values – the cost of debt, and the expected return on equity investment, which is estimated with a market analysis. Following CDM Executive Board guidance in 2008 (CDM Executive Board 2009), hydropower projects registered in India in the last two years commonly calculate the expected return on equity using the Capital Asset Pricing Model (CAPM). CAPM estimates the equity return required by investors from a project as a risk free rate (e.g. government securities), plus a risk premium that takes into account the higher expected IRR needed to counterbalance the risk associated with the particular project type. CAPM uses the following formula based on historical return on equity:

$$\text{investor expected return} = \text{risk free rate} + (\text{market rate} - \text{risk free rate}) * \text{beta}$$

where government securities are typically used for the risk free rate, the market rate is the rate of return from the stock market generally, and beta captures the correlation between the fluctuation of the value of stocks in the specific industry of the project being analyzed and the stock market generally. For example, the milk industry should have a low beta, since purchases remain relatively steady regardless of the state of the economy, but luxury goods have high betas, since their purchase rates increase and decrease according to the state of the economy. In other words, beta indicates if hydropower investments are more risky or less risky than the stock market in general.

The risk free rate is fairly straightforward – this is the rate of return on investments that have very low risk, such as government bonds. The market rate and beta are both less straightforward, and values have differed considerably among the CDM applications of similar projects in a single country.

The CAPM model, while considered one of the most reliable ways of determining expected return on investment, is very dependent on assumptions used. We provide a simple example to illustrate this. Bhilangana III, a 24 MW hydropower project in India registered under the CDM in 2011, defines their viability benchmark using WACC. The interest rate on their debt is taken as the prime lending rate from the Reserve Bank of India as 9.62% at the time the development decisions was made. The CAPM model is used to estimate the expected investment return.

We examine just one of the inputs into the CAPM model – the market rate, which is the expected return of the stock market. The developers of Bhilangana III calculate the market rate as the average annual percentage increase on stock market values of the top 500 companies on

²² Weighted Average Cost of Capital (WACC) is the cost of capital to the project developers, normally combining two components: the costs of a loan (loan interest rates) and the costs of equity (return on equity required by an equity investor).

²³ Executive Board Report 51, Annex 58, *Guidelines on the Assessment of the Investment Analysis (version 3)*, report from EB meeting ending 4 December 2009, http://cdm.unfccc.int/EB/051/eb51_repan58.pdf

the Bombay stock exchange (BSE 500) between February 1999 and February 2006. The choice of end date is the month that the investment decision was made. They chose the beginning date, February 1999, as the year of inception of BSE 500. The benchmark derived is 13.18%. If instead, February 2000 had been the first year with available BSE 500 data, the market rate would have been 3% lower, generating a benchmark WACC as 10.11%. The IRR of the project without carbon credits is calculated as 10.49%. The IRR of the project would have been above the benchmark and the project would not have been considered non-additional if the market return calculation started in February 2000 instead of February 1999, an arbitrary choice.

Other hydropower projects registered in India around the same time calculate benchmarks that range from 11.0% to 15.8% using the same method, by choosing different CAPM model parameters.

3.2.3 Examination of IRR analysis

We start this discussion with wind power development in India – a best case technology for an accurate IRR analysis – and then draw a comparison with hydropower. Wind power in India is a best case for an accurate IRR analysis because almost all investment analysis inputs are recorded in legal agreements before construction starts. Wind development in India involves a supply agreement between a wind developer and an investor whereby all of the major costs are agreed in formal documents before construction starts. In addition, most states in India publish their wind power tariffs paid to the project owner per kilowatt hour produced that would apply to all new wind development. Even so, for the majority of large wind projects registered in India, the choice of assumption about one cost input that is not pre-determined in the majority of cases – the tariff after the end of the first power purchasing agreement – can affect expected project financial return by around the same amount as expected increase by carbon credits (Haya under preparation). This means that wind power developers have some leeway to choose investment analysis inputs that could show that a feasible wind project is infeasible.

An investment analysis for a hydropower project involves much more uncertainty than for a wind project. For one, from the perspective of the project investor, the costs contained in wind project supply agreement are the actual costs that will be paid to the wind manufacturer. For a hydropower project, the capital costs documented in documents cited in the CDM project applications (Detailed Project Reports, feasibility studies, techno-economic clearance report, loan agreements, etc.) are best estimates. Actual costs can be less or more than what is written in these documents. Cost predictions for a single project often vary between project documents for a single project as cost estimates are revised over time. Hydropower is notorious for large cost overruns, but also in some instances has been less expensive than predicted (World Commission on Dams 2000). In addition, the perceived risk of cost overruns or project underperformance certainly influence project development decisions, but is not recorded in a citable document.

Further, as discussed above, there are many benefits of hydropower that are not easily quantified in an investment analysis, but when not quantified lead to a project appearing less cost effective than it actually is. Such benefits include energy security, the flexibility of being able to be used for base load and for peak load, and other uses for multi-purpose dams.

The investment analysis is accurate to the extent that developers report the same cost and revenue assumptions and benchmark in their CDM applications as they use in their internal decision-making. Uncertainty in investment analysis inputs enables a range of possible values,

from which the project proponent could choose strategically to show the project is less viable than it may actually be. This analysis of ranges of acceptable benchmarks and capital cost estimates shows that in the case of hydropower there is substantial room to choose assumptions.

3.2.4 More evidence that the IRR analysis is not filtering out non-additional projects

The timing of the start of project construction of CDM hydropower projects provide additional evidence that many non-additional hydropower projects are currently registered under the CDM. The *starting date of the project activity* documented in each PDD gives the date when project construction started or otherwise when “real action of a project activity begins/has begun” (CDM Executive Board 2008). Starting dates for 16% of all registered hydropower projects (180 projects) were prior to when the Kyoto Protocol entered into force on February 16, 2005.²⁴ Of these, 60% were registered in 2007 or later. The starting dates of 89% of all registered hydro projects were before the start of the validation process (start of the public comment period) indicating that certainty about a positive validation or registration was not needed for the decision to build the project to be made.²⁵

3.3 WHEN SHOULD HYDROPOWER BE CONSIDERED COMMON PRACTICE?

The *Additionality Tool's* common practice assessment provides a “credibility check” on the investment and barrier analyses. The common practice assessment requires discussion of activities that are in operation and are similar to the proposed CDM project in terms of location, technology and scale. As per the *Additionality Tool*, if similar activities are “widely observed and commonly carried out,” the developer must explain “essential distinctions” between the proposed project and other similar activities in terms of financial attractiveness or the presence of barriers. Projects in the CDM pipeline are excluded from the comparison.

3.3.1 Is hydropower common practice?

Worldwide hydropower is a conventional technology. Around 8,700 hydropower projects with dams at least 15 meters in height²⁶ and an uncounted number of smaller dams produce 16% of global electricity supply (Kumar et al 2011). As discussed above, hydropower is common practice in China and India. In Vietnam, with the third largest number of hydropower CDM projects, 36% of the country’s electricity production is from hydropower.²⁷ In Brazil, the country with the fourth largest number of proposed and registered CDM projects, 84% of the country’s electricity generation is from hydropower.²⁸ Hydropower is a mature technology, which has played an important part in electricity generation since the beginning of electricity generation.

The extent to which small and micro hydropower is common practice is less clear than for large hydropower and would need to be assessed for different size classes for each country,

²⁴ The starting dates for all registered CDM projects and projects in the validation stage are listed in IGES Institute for Global Environmental Strategies (IGES). 2011. IGES CDM Project Database. Japan: 1 September 2011

²⁵ The start of the public comment period is listed in the same database.

²⁶ Listed in the World Register of Dams, a database maintained by International Commission on Large Dams (ICOLD)

²⁷ International Energy Agency website http://www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=VN, accessed 21 October 2011

²⁸ US Energy Information Administration website <http://www.eia.gov/countries/cab.cfm?fips=BR>, accessed 21 October 2011

and if appropriate for different states or provinces. As mentioned above, small hydropower is defined differently in different countries, and typically attracts less government interest and government involvement than large hydropower. But small hydropower is already common practice in some countries. For example, China's small hydropower should be considered common practice due to the capacity that already exists in the country, and China's plans to continue to build small hydropower as the main way to meet China's rural electrification goals.

3.3.1 How common practice is being assessed

In China, 739 hydropower projects in China passed the common practice assessment and were successfully registered under the CDM. Many of them passed the test by defining "similar" projects narrowly, and then describing how the proposed CDM project faces more hardship in at least one way compared to each of the projects that are still considered similar to it. For example, Longjiang 240 MW Hydropower Project in Yunnan Province (CDM ref #4859) in China's southwest noted eleven medium-sized hydropower projects (50-300 MW) that started construction in the province after 2002 (when structural changes were made to China's electric power sector) and were in operation by 2008 (narrowly defined assessment boundaries). Of these eleven projects, seven projects are excluded from the analysis because they are in the CDM pipeline, registered under a voluntary offsets program, or sold power to a different grid within China. The following essential distinctions are then described between the proposed CDM project and the four remaining "similar" projects: the proposed CDM project expected lower financial return compared to one project, was offered a lower tariff compared to two projects, and expected a higher cost per kilowatt compared to the last similar project. Other reasons commonly used by Chinese hydropower project developers to describe their projects as distinct include that the expected capacity factor is lower than for other projects, and that the project developer is a private sector developer while most hydropower is built by state owned enterprises with preferential treatment from the government. Each of these distinctions may indeed be factually true for a particular comparison between two projects. However, if a project is considered distinct if it is less attractive than a similar project in only one way among many, it can always prove that it is distinct. By allowing "similar" to be defined so narrowly, and "essentially distinct" so broadly, practically any project can show it is not common practice, even if it is sitting in a sea of hydropower development.

It is important to mention one more problem with the way common practice assessments are carried out. If additionality testing were perfectly accurate, it would be appropriate to leave out other similar projects that are in the CDM pipeline from the common practice analysis. In China, well over half of all hydropower projects that came on line in 2007 are in the CDM pipeline (Bogner & Schneider 2011). If some of these projects are in fact non-additional, which we are arguing could easily be the case for a large proportion of them, then they would be incorrectly excluded from the common practice analysis and the effectiveness of the common practice test as a credibility check would be compromised.

Our assessment of how the common practice test is being applied to hydropower projects in China indicates that the common practice assessment is not being used in a meaningful way. The boundaries defining what projects are "similar" to the proposed CDM project must be judged conservatively in the conditions of the particular sector and technology. A change in the structure of a sector, such as the breakup of the national Chinese power company in 2002, should not mean that projects built after 2002 are dissimilar from those built before 2002, since

hydropower development was supported before and after the change in the sector. Projects under construction and other projects in the CDM pipeline should be included in the common practice assessment. If a technology is deemed common practice, then projects using that technology should be considered common practice without the ability to show that they are “essentially distinct” which has been shown to be easy to do and therefore not meaningful.

3.4 DISCUSSION

In examining the additionality of large hydropower CDM projects we find three main reasons why large hydropower does not meet the CDM’s additionality requirements:

- Financial return is not a good predictor of whether a project will be built because non-financial factors have a large influence on the decision to develop large hydropower projects.
- Uncertainty in investment analysis inputs allows project developers to choose input values strategically in order to show that their projects are less financially viable than they really are. These first two points mean that the investment analysis is inappropriate and inaccurate for large hydropower.
- Large hydropower is a well-established technology that is heavily promoted by governments and therefore does not meet the requirement that CDM projects should not be common practice.

Small hydropower typically benefits from less political backing and is thus more likely to involve private developers for whom financial return is more predictive of the development decision. However, the investment analysis is unreliable for small hydropower for the same reason as for large hydropower – because of uncertainty in input values. In some countries small hydropower is already being built at substantial rates and therefore should not pass the common practice test. In countries where there already is development of small hydropower projects, such as in China and India with supportive subsidies and tariffs, allowing small hydropower project to register under the CDM means potentially allowing a substantial portion of non-additional projects to register. Instead, types of small hydropower, defined by their size and location, and perhaps other objective characteristics, should be identified that are not currently being built, but which could be effectively enabled by the help of carbon credits. The effects of the CDM should be evaluated over time and should be clearly discernable for those projects types to continue to be eligible for crediting.

4 SOCIAL AND ENVIRONMENTAL IMPACTS OF HYDROPOWER

4.1 ENVIRONMENTAL IMPACTS

Dams, interbasin transfers and diversion of water for irrigation purposes have resulted in the fragmentation of 60% of the world’s rivers (Revenga et al. 2000). In the following sections we summarize the main environmental impacts of hydropower plants.

4.1.1 Impacts by size and type of hydropower plant

It is difficult to correlate the damage caused by dams to their size or type, as the impacts depend on local conditions. Generally small dams for non-energy purposes are considered to be less environmentally damaging than large dams and hydropower dams, but there have been

fewer studies documenting the impacts of smaller dams (Kibler 2011) and run-of-river dams. Gleick (1992) found that small hydropower facilities in the United States (< 25 MW) tended to exert greater ecological cost per unit of electricity produced compared to larger projects. A comparison of small and large hydropower projects on the Nu River in China also found that small projects more adversely impacted habitats, water quality and hydrology on per megawatt basis, relative to large dams (Kibler 2011).

Also, small hydropower projects are subjected to fewer regulations and less scrutiny in many countries. In China, small hydropower plants (< 50 MW) can be approved at the prefectural or provincial level, rather than the national level (Kibler 2011) and therefore are subjected to fewer additional checks (Kibler 2011). Small projects are permitted as individual projects, therefore cumulative impacts of multiple dams within a watershed are not considered. While large projects in India are granted clearance from the central government and required to carry out an Environmental and Social Impact Assessment, small projects are not required to conduct such an assessment except under special conditions (MOEF 2006). Projects between 25 and 50 MW require clearance from the environmental entity of the state that the project is located in, while projects smaller than 25 MW do not require any permits (MOEF 2006).

Run-of-river hydropower plants are generally less damaging than reservoir power plants, because it is not necessary to flood large areas upstream of the project for storage. Yet in some cases run of river impacts can also be severe due to river diversion over long stretches of the river. Also there is no standard defining the maximum storage size allowed for a RoR plant. Thus there have been cases of developers taking advantage of this ambiguity to misclassify their project as RoR so that it appears more environmentally benign (McCully 2001).

4.1.2 Impact of reservoirs

Dams have major impacts on the physical, chemical and geomorphological properties of a river (McCully 2001, WCD 2000). Environmental impacts of dams have largely been negative (WCD 2000). Worldwide, at least 400,000 square kilometers have been flooded by reservoirs (McCully, 2001). Impacts of hydro power projects extend to the construction of the support infrastructure including the construction of roads and power lines (Egré and Milewski 2002). Other secondary impacts include clearing of land upstream by communities that have been displaced (WCD 2000, McCully 2001). Such clearing can lead to further loss of biodiversity and increases in erosion.

Large dams with reservoirs significantly alter the timing, amount and pattern of riverflow. This changes erosion patterns and the quantity and type of sediments transported by the river (WCD 2000, McCully 2001, Kumar et al 2011). Sedimentation rate is primarily related to the ratio of the size of the river to the flux of sediments (McCully 2001, Kumar et al 2011). The trapping of sediments behind the dam is a major problem (WCD 2000, McCully 2001, Kumar et al 2011). Every year it is estimated that 0.5 to 1% of reservoir storage capacity is lost due to sedimentation (Mahmood 1987). Trapping of sediments at the dam also has downstream impacts by reducing the flux of sediments downstream which can lead to the gradual loss of soil fertility in floodplain soils.

Dams can also lead to changes in temperature and chemistry of the water in the reservoir and downstream. These changes often create more favorable conditions for non-native species (Thomas 1998). For example, aquatic weeds such as water hyacinths and orange fern have

become problematic in tropical and African reservoirs (WCD 2000, McCully 2001). A rise in temperature and accumulation of nutrients in the reservoir can cause algal blooms (WCD 2000 McCully, 2001), which in turn can lead to anoxic conditions during decomposition. Increases in certain types of bacteria in reservoirs can lead to the release of mercury from sediments and lead to the bio-accumulation of mercury in fish, a common problem in reservoirs (WCD 2000, McCully 2001).

4.1.3 Impact of river diversion

While both RoR and reservoir types of hydropower dams may divert water, this is always the case with RoR plants, since they seek to increase kinetic energy with an increased head. The length of diversion can range from a few meters or less to kilometers (km). For example, the Teesta V RoR dam in northeastern India diverts water for a 23 km long stretch of the river (Neeraj et al 2010). Eventually the diverted water is returned to the river. There have been fewer studies documenting the impacts of RoR and diversion projects. Nevertheless impacts can be significant. Often downstream flows are reduced considerably or even completely eliminated during certain periods of time with sudden intervals of high flows (Englund and Malmqvist 1996, Kibler 2011). Such drastic variability in water flow impacts the structure of aquatic ecosystems often leading to a loss of biodiversity (Englund and Malmqvist 1996, Kibler 2011). A decrease in fish populations has been observed in dewatered reaches below diversions (Amodovar and Nicola 1999, Kubecka et al 1997, Anderson et al 2006). After long periods of little to no flow some species may not be able to recover and go extinct (Kibler 2011). Also, under normal conditions, increased sediment transport from low to intermediate flows provides a warning to aquatic organisms that high flows may follow. Abrupt changes from low to high flows obliterate this cue, making it difficult for organisms to respond to impending environmental changes (Kibler 2011).

4.1.4 Impact on fisheries

Dams and river diversion can impact freshwater, as well as marine fisheries. Estuarine and marine fisheries are dependent on estuaries and rivers as spawning grounds and the transport of nutrients from the river to the sea. For example, the productivity in Mediterranean coastal waters is lower due to the reduction of nutrients transported to sea because of the construction of the Aswan dam (Aleem 1972, Drinkwater and Frank 1994).

Migratory fish are especially vulnerable to the impacts of dam construction. Dams can prevent migrating fish such as salmon and eel to reach their spawn grounds (WCD 2000). A survey of 125 dams by the WCD reported that blocking the passage of migratory fish species has been identified as a major reason for freshwater species extinction in North America. Lower catch is a common side effect of dams and has been reported worldwide (WCD 2000). There have been cases where fishery production below a dam has increased due to controlled discharge of the sediments. For example at Tucuruí Dam in Brazil there have been an increase in the productivity of the fishery, but there are fewer number of species found (WCD 2000).

4.1.5 Impacts of multiple dams

Few studies have analyzed the cumulative impacts of multiple dams on a particular river, but the WCD (2010) has documented some. Placing 24 dams on the Orange-Vaal River in South Africa has led to changes in temperature on almost two-thirds of the river (2,300 km), which

affects the habitat of flora and fauna. Cumulative impacts of multiple small dams is especially important, since multiple small dams are often built on one river and its tributaries to increase power output. An analysis of proposed small (< 15 MW) hydropower projects on the Salmon River in the United States found that the combined effect of the dams proposed on that river could exceed those associated with the sum of the effects of each single project on their own (Irving and Bain 1993). Further studies are needed to increase our understanding of the interplay between multiple small dams.

4.1.6 Greenhouse gas emissions from reservoirs

Freshwater reservoirs can emit substantial amounts of the greenhouse gases methane and carbon dioxide as organic matter submerged in a reservoir decays under anaerobic and aerobic conditions, respectively (St. Louis et al. 2000, Fearnside 2004, Giles 2006).

From the limited number of measurements, GHG emissions from hydropower reservoirs in boreal and temperate region are low relative to the emissions from fossil fuel power plants, but higher relative to lifecycle emissions from wind and solar power (Mäkinen and Khan 2010). Tropical reservoirs with high levels of organic matter and shallow reservoirs have higher emission levels (Soumis et al. 2005). A recent compilation of greenhouse gas emissions from reservoirs found a correlation between the age of the reservoir and latitude (Barros et al. 2011). Younger reservoirs and those in low latitudes are the highest emitters. For example, one study of four Brazilian dams in the Amazon, showed that the GHG emissions factor of the electricity produced by those hydropower dams exceed those from a coal-fired power plant (Fearnside 2004, Kemenes et al. 2007).

To account for these GHG emissions the CDM Executive Board uses a threshold criterion to determine the eligibility of hydroelectric plants for CDM projects. Table 1 below summarizes the thresholds.

Table 1: How GHG emissions from hydropower projects are treated under the CDM
(Source: Mäkinen and Khan 2010).

Power Density (W/m ²)	CDM Rules
< 4	Excluded from using currently approved methodologies
4-10	Allowed to use approved methodologies, but project emissions must be included at 90 g CO ₂ eq/kilowatt hour
> 10	Allowed to use approved methodologies and project emissions can be neglected.

Projects with low power densities (< 4 Wm²) are not explicitly excluded from the CDM, but developers of such projects would need to create a new methodology and gain approval in order to apply for registration under the CDM. We tested the thresholds on a number of tropical hydropower reservoirs and found that they are effective at preventing projects with high greenhouse gas emissions from entering the CDM pipeline and can also account for emissions from hydropower reservoirs with power densities lying in the middle range.

4.2 SOCIAL IMPACTS

Similar to other large infrastructure projects, dams have both negative and positive social impacts. The benefits of hydropower include electricity from a local resource that has negligible

GHG emissions in most cases, delivery of peak power, and the avoidance of the health and environmental impacts associated with fossil fuels, especially coal. Multipurpose dams can also reliably deliver water and flood control as well as other ancillary services. On the other hand, displacement, loss of livelihood, poorer health and loss of cultural heritage²⁹ are some of the worst impacts (WCD 2000, McCully 2001, Kumar et al 2011). Often groups that bear the social and environmental costs of dams are not the ones who reap the benefits. Poor, vulnerable groups such as rural populations, subsistence farmers, indigenous communities and ethnic minorities often bear a disproportionate share of the negative impacts, while the main beneficiaries are urban dwellers, commercial farmers and industries (WCD 2000).³⁰

4.2.1 Displacement

It is estimated that 40-80 million people have been physically displaced by dams worldwide (WCD, 2000). In India and China alone, 26-58 million people have been displaced between 1950-1990 due to dam projects (Fernandes and Paranjpye 1997). These figures do not include displacement from other factors such as construction of canals, powerhouses or project infrastructure. In-depth case studies of eight large dams on four continents by the WCD (2000) found that in each case the expected number of displaced persons was initially underestimated by 2,000 – 40,000 people. Among dams funded by the World Bank, 47% more people were displaced than initially estimated (WCD 2000). The WCD case studies show that downstream communities, landless peasants and indigenous people are often not counted as project-affected and therefore often do not receive compensation. The impacts for down-stream communities are often only clear after the dam comes into operation and often impacts worsen over time. (WCD 2000). Resettlement has mostly been involuntary and there has been little meaningful participation of those affected in the resettlement and rehabilitation process (Cernea 1999, Bartholeme et al. 2000, Scudder 2005). In the most extreme cases, violence has been employed to force eviction.³¹

Compensation usually only occurs once as a cash payment or in the form of an asset such as housing and/or land (Bartolome and Danklmeier 1999, WCD 2000b). Lands provided for resettlement are often resource-depleted and environmentally degraded areas (WCD 2000). The focus of resettlement programs is on physical relocation, rather than economic and social development (Cernea 2000, WCD 2000b). In China, almost half (46%) of those displaced are living in extreme poverty (Driver 2000). In India, 75% of people displaced by dams have not been rehabilitated³² (Cernea 2000). The larger the number of people displaced from a project, the less likely that resettlement will be adequate due to lack of enough suitable land (WCD 2000).

²⁹ The socio-cultural impacts of displacement by large dams on communities has been poorly documented because socio-cultural impacts are intangible, making them difficult to monetize (McCully 2001, Koenig and Diarra 2000, Pandey 1998). Displacement often results in the loss of sacred land and common property resources (Casparly 2007). A study of a village displaced by the Rengali Dam in eastern India found a breakdown in family and community structures (Behura and Nayak 1993). Alienation and marginalization are major risks for displaced communities (Cernea 1999).

³⁰ For example, although indigenous people are 8% of India's population, they comprise 60% of those displaced by dams there (WCD 2000a). Almost all of the large dams in the Philippines that have been built or proposed are on the land of indigenous people (WCD 2000a).

³¹ For example: Over 350 Maya Achi people were killed during the forced eviction at the Chixoy Dam Site in Guatemala (Stewart et al. 1996). Over 1,000 people of the Ngobe tribe have been forcibly removed from their homes due to construction of Changuinola Dam in Panama (UN 2009).

³² Rehabilitation refers to economic, social and psychological adjustment after displacement.

4.2.2 Health impacts

Impacts on human health from large dams include an increase in vector-borne diseases in tropical regions, lower water quality and food insecurity (WCD 2000). The edge of tropical reservoirs and irrigation canals provide ideal conditions for disease-vectors such as insects and snails. McCully (2001) has documented numerous examples of the spread of schistosomiasis³³ after the construction of dams. Increases in transmission of malaria due to the construction of reservoirs and irrigation canals in malaria-prone areas have also been reported (World Bank 1999). Other health impacts include the release of toxins by cyanobacteria³⁴ due to rapid eutrophication in new dams and the bioaccumulation of mercury in fish, which is released from soil by bacteria decomposing organic matter in the reservoir (WCD 2000).

4.3 CONCLUSION

While hydropower dams can produce power with low GHG emissions and can in the case of multi-purpose dams also deliver flood and irrigation control, the adverse social and environmental costs can be substantial, as we have described above. Such negative impacts are not compatible with the promotion of sustainable development, one of the core objectives of the CDM. Evidence indicates that on the whole the CDM has not effectively fulfilled its sustainability objective (Boyd et al. 2009, Schneider 2007). This seems to hold true for hydropower projects as well. There is much anecdotal evidence that some hydro projects have been registered under the CDM despite their significant negative impacts. Table 2 gives a few examples of such projects.

The increase in opposition to large dams in developing countries by projected-affected persons and their supporters has led to the development of frameworks and standards to analyze and minimize project impacts that are dam specific, most notably the World Commission on Dams (WCD) criteria and guidelines. In the next section we discuss how the EU has used the WCD criteria to screen hydro projects that sell CERs into the EU-ETS. We also include a discussion of how the EU's process could be improved to increase the effectiveness of the screening.

³³ Schistosomiasis or bilharzia, is a parasitic disease caused by trematode flatworms. Schistosomiasis causes damage to the bladder, kidneys, liver, spleen and intestines.

³⁴ Humans are affected with a range of symptoms including skin irritation, stomach cramps, vomiting, nausea, diarrhea, fever, sore throat, headache, muscle and joint pain, blisters of the mouth and liver damage.

Table 2: A selection of registered hydropower projects with considerable adverse impacts

Allain Duhangan Dam (192 MW), India, Approved May 2007

The project has suffered from inadequate rehabilitation of affected villages and environmental violations. The Office of the Compliance Advisor/Ombudsman of the International Finance Corporation (2005) verified that the project developer had not ensured enough irrigation and drinking water for affected villages. The project was also temporarily halted and fined for violations of Indian forest conservation law due to illegal felling of trees, dumping of waste and road construction.³⁵

Bhilangana (22 MW), India, Approved January 2007

Affected villagers never consented to the project and actively opposed the project.³⁶ Villagers opposed to the project were jailed multiple times and 29 people were arrested in November 2006 were forced to sign a document stating that they would stop resisting the project.³⁷ Significant physical abuse by the police was reported.³⁸

Jorethang Loop (96 MW), India, Approved February 2008

A survey of the affected villages by an Indian NGO after the public hearing found that many villagers were not informed about the meeting (McCully 2008). Requests by villagers and NGOs of project documents including the environmental impact assessment were ignored by the project developer (McCully 2008).

Xiaoxi (135 MW), China, Approved December 2008

A field report commissioned by International Rivers³⁹ documented problems include the forced eviction of 7,500 people, a failure to restore pre-eviction incomes, arbitrary and inadequate compensation for resettlers, a lack of legal recourse for those who suffered losses, and a non-independent EIA process marred by conflict of interest.

El Chaparral (65 MW), El Salvador, Approved March 2010

The public consultation process has been criticized as being neither open nor transparent. Adverse impacts include the displacement of 10,000 families in three municipalities, habitat loss of endangered flora and flooding of archaeological artifacts. The dam has divided and destabilized the community between those in favor and those opposed.⁴⁰

Barro Blanco (29 MW), Panama, Approved January 2011

Although the dam site is in an area recognized by the Panamanian government as collective property of the Ngobe indigenous people, only members of non-indigenous population were consulted. The project developer has also been accused of human rights abuses. An investigation by the European Investment Bank into human rights abuses at the dam site resulted in the project developer retracting their loan request and only then applied for registration under the CDM.⁴¹

³⁵ <http://www.internationalrivers.org/en/blog/payal-parekh/cdm-changing-lives-worse>
Hydropower in the CDM: Examining Additionality and Criteria for Sustainability

5 ASSESSING THE EUROPEAN UNION'S SCREENING CRITERIA FOR HYDROPOWER

In order to minimize the negative impacts of hydropower effective screening criteria are needed. Yet assessing and mitigating the social and environmental impacts of hydropower projects is difficult and complex at best. Deciding whether the benefits of constructing a hydropower plant outweigh the costs requires multiple factors to be considered and weighed. Many of the impacts such as loss of traditional ecological knowledge or biodiversity are difficult to monetize and compare against one another (Koenig and Diarra 2000, Pandey et al. 1998). A cost-benefit approach is also problematic in cases when those that bear the social and environmental costs of a dam are not the same as those who benefit. As shown in the previous section, neither size (installed capacity) nor type are effective predictors of environmental and social impacts of hydropower dams. Additionally, empirical data from which to draw robust relationships is sparse (Poff and Hart 2002). Therefore classifying environmental and ecological impacts of dams based objective criteria such as dam size or type is difficult because impacts are influenced by the interactions among natural processes, dam characteristics and management practices (Poff and Hart 2002).

In the following sections we discuss efforts that have been made to develop such screening criteria. We summarize the World Commission on Dams criteria and discuss how they have been implemented in the European Union. In our analysis on the effectiveness of such criteria we also highlight the Gold Standard stakeholder process and discuss how the evaluation and verification processes could be improved to strengthen the effectiveness of such screening criteria.

5.1 WORLD COMMISSION ON DAMS CRITERIA

In 1998 the International Union for the Conservation of Nature (IUCN) and the World Bank established the World Commission on Dams (WCD) in response to growing public scrutiny of large dams. The mandate given to the Commission was to

- *review the development effectiveness of large dams and assess alternatives for water resources and energy development; and*
- *develop internationally acceptable criteria, guidelines and standards for the planning, design, appraisal, construction, operation, monitoring and decommissioning of dams.*

Dams and Development (WCD, 2000), the report of the commission includes a comprehensive framework for energy and water planning to ensure that adverse impacts from dam projects are minimized and the benefits and costs are more evenly distributed among

³⁶ SANDRP Comments on Bhilangana PDD, see <http://www.internationalrivers.org/global-warming/carbon-trading-cdm/sandrp-comments-bhilangana-hydro-project-uttaranchal-india>

³⁷ Asian Human Rights Commission, available at <http://www.humanrights.asia/news/urgent-appeals/UP-164-2005>

³⁸ Ibid.

³⁹ <http://www.internationalrivers.org/en/node/3006>

⁴⁰ CESTA Letter to CDM Board on El Chaparral Hydroelectric Project, see <http://www.internationalrivers.org/en/am%C3%A9rica-latina/cesta-letter-cdm-board-el-chaparral-hydroelectric-project-el-salvador>

⁴¹ Letter to the CDM Executive Board, see <http://www.internationalrivers.org/node/6215>

stakeholders. The report is considered the most comprehensive, independent and thorough review of large dams to date.⁴²

The WCD criteria go beyond a simple Environmental Impact Assessment (EIA), as it creates a process meant to address the complex set of considerations involved in dam development decisions. These include the recognition that most dams have negative impacts, and that the distribution of costs and benefits among different sectors of society is often unequal. Seven strategic priorities based on principles of equity, efficiency, participatory decision-making, sustainability and accountability were defined. They are:

1. **Gaining Public Acceptance:** There must be public acceptance of the project by affected people. Indigenous and tribal communities should give free, prior and informed consent.
2. **Comprehensive Options Assessment:** All possible options for water and energy resource management should be considered. Social and environmental aspects should be weighted equally as financial and economic factors.
3. **Addressing Existing Dams and Hydroelectric Projects:** New projects should be considered only after existing projects are at maximal efficiency.
4. **Sustaining Rivers and Livelihoods:** Location of a new dam should be chosen so as to minimize adverse environmental and social impacts.
5. **Recognizing Entitlements and Sharing Benefits:** Projected affected persons must be adequately resettled and rehabilitated and mitigation strategies should be implemented to sustain ecosystems and livelihoods.
6. **Ensuring Compliance:** Compliance by the developer of regulations, guidelines and agreements must be ensured.
7. **Sharing rivers for peace, development and security:** There should be cooperation and agreement for dam construction on transboundary rivers.

The WCD developed a decision-making process with five stages in order to fulfill the priorities. They are 1. Needs assessment; 2. Selection of alternatives; 3. Project preparation; 4. Implementation of project; 5. Operation of project. A further set of 26 guidelines outlines how to assess options, plan and implement dams projects in order to fulfill identified criteria for each stage of decision-making.

This short summary of WCD substance and process criteria make it clear that WCD requirements are extensive and complex. In the next section we discuss how the EU has used these criteria for their requirements for large CDM hydro project that wish to sell their CERs into the EU-ETS.

5.2 THE EUROPEAN UNION'S WCD CRITERIA TO ASSESS CDM HYDRO PROJECTS

⁴² The World Commission on Dams was a multi-stakeholder body that established the most comprehensive guidelines for dam building. The twelve members of the Commission were drawn from industry, government, academia and civil society. The Commission created a 68 member Stakeholder Forum with participants on various sides of the dam debate that served as an advisory group to the Commission. To gather information and data for the assessment, the WCD organized four regional consultations, performed case studies of eight large dams on five continents, commissioned country studies of China and India, undertook 17 thematic reviews of a wide range issues from environmental to institutional issues and conducted a global survey of 125 dams in 56 countries to "cross-check" the findings of individual studies.

The EU-ETS, launched in 2005, covers about 50% of the EU's CO₂ emissions and is currently the largest cap-and-trade system in the world and also the largest buyer of CERs.⁴³ The EU has placed several restrictions on what types of CERs can be used in the EU-ETS. To address concerns that hydropower projects can have serious environmental and social impacts, the EU added additional requirements for projects larger than 20 MW:

[...] Member States shall, when approving such project activities, ensure that relevant international criteria and guidelines, including those contained in the World Commission on Dams November 2000 Report "Dams and Development A New Framework for Decision-Making", will be respected during the development of such project activities. (Article 11b(6) of the Linking Directive)

The issue of how and if to restrict the use of credits from CDM hydro projects was contentious and the opinions between Member States varied considerably.⁴⁴ The final document was approved in 2004 and requires WCD criteria to be met for hydropower plants that are larger than 20 MW.

The language of Article 11b(6) of the linking directive is vague. For example, the text states that Member States are obliged to comply with 'relevant' international criteria and guidelines, 'including' those contained in the WCD. Up until 2008 there was no harmonized approach in the EU and the requirements for large hydro projects were interpreted differently by each Member State and implemented with varying degrees of rigor. This raised doubts about the environmental and social integrity of CERs entering the ETS and led to uncertainty and fragmentation in the European CER market. Many carbon exchanges excluded CERs from large hydro for fear that individual EU member states may refuse to accept them. In other words, "there was a danger that mutual recognition by Member States of national project approval decisions might break down" (Scott, 2011).

While the WCD evaluation and criteria are very comprehensive (the report is several hundred pages long), they do not include an evaluation process that could be used to assess WCD compliance ex-post. In 2008, the EU launched an effort to do exactly that: operationalize and harmonize the WCD criteria for the evaluation of large CDM hydropower projects. The European Commission launched an ad-hoc process of 'voluntary coordination' of Member State regulation of large hydro projects. In late 2008, all 27 Member states adopted uniform guidelines on the application of the linking directive's hydropower requirements (EU, 2008a), and a common compliance report template (EU, 2008b). All EU Member States agreed to use these harmonized criteria as of 1 July 2009:

⁴³ The EU-ETS is linked to the CDM via its 'linking directive' (Directive 2004/101/EC). This makes it possible for installations covered under the EU-ETS to use a certain proportion of CERs to meet their emission reduction obligations. In the 2nd and 3rd trading periods (2008-2020), up to half of the EU-ETS emission reductions can be met by using CERs and credits from Joint Implementation (JI). About 277 million CERs have been surrendered in the EU-ETS to date. 2% of those credits have come from large hydro projects (Sandbag, personal communication). Total demand for CERs in the EU-ETS until 2020 is estimated to be around 2.7 billion. In the sectors not covered under the ETS, such as agriculture and transportation, it is the EU member states that can choose to purchase CERs to achieve compliance with European emission reduction obligations.

⁴⁴ Germany, the Netherlands, Sweden and Belgium pushed for the inclusion of WCD requirements whereas Spain, France, Portugal, Italy, Greece, Austria, Finland and Estonia were opposed. There was also controversy about the threshold (10 MW or 20 MW) and a particularly fierce debate was held over whether compliance with WCD standards should be mandatory or whether Member States should simply be required to take them into account. For a more detailed history on the negotiations around the linking directive, see Hægstad Flåm, 2007.

Once a project activity has received a Letter of Approval (LoA) from an investor country upon the submission and positive assessment of a validated Article 11b(6) Compliance Report, all Member States agree to accept CERs/ERUs from this project for use in their national registries under the EU ETS. (EU WCD guidelines, 2008)

This means that in addition to the CDM application materials required by the UNFCCC, project developers are required to submit an Article 11b(6) Compliance Report to the Designated National Authority (DNA) of the Member State. The Compliance Report must be validated by a Designated Operational Entity (DOE).

The *Guidelines on a common understanding of Article 11b (6) of Directive 2003/87/EC as amended by Directive 2004/101/EC*, as the guidelines are officially called, include nine pages of guidelines including background information on the linking directive and the WCD spells out the procedural and content requirements needed for compliance.

The template of the compliance report, called *Compliance Report Assessing Application Of Article 11 B (6) Of Emissions Trading Directive To Hydroelectric Project Activities Exceeding 20 MW* is 17 pages long and includes specific questions on the seven strategic priorities of the WCD to evaluate compliance, these include:

Section 1: Description of the project, includes questions on dam height, total submerged area, number of displaced inhabitants and information on related infrastructure being build (e.g. access roads).

Section 2: Assessment of compliance with the WCD criteria:

1. Gaining public acceptance, includes questions on the number of people affected by the project, how stakeholders were identified, informed and involved in the in the decision-making process, and how compensation and benefit agreements correspond with the identified needs and rights of the stakeholders negatively affected upstream and downstream due to the project. It also includes a question on how transparency was ensured.

2. Comprehensive options assessment, includes questions about the needs for hydropower, potential alternatives and reasons for project choice and site selection.

3. Addressing existing dams/hydroelectric projects, includes questions on national monitoring requirements for social and environmental issues and questions about how social and environmental issues of existing dams have been resolved.

4. Sustaining rivers and livelihoods, includes questions about impact assessment (environmental and social) and cumulative impacts.

5. Recognizing entitlements and sharing benefits, includes questions about mitigation, resettlement and development plans and compensation packages.

6. Ensuring compliance, includes questions about complying with relevant laws, regulations, agreements (including resettlement and compensation agreements) and about the legal nature of the compensation agreements.

7. Sharing rivers for peace, development and security, includes questions about trans-boundary impacts

The EU took a laudable and important step in developing these two documents to operationalize the WCD guidelines. It is a difficult and complex task to come up with guidance and requirements that capture the criteria in a meaningful and yet implementable way. Although

the harmonization effort has led to a more uniform application of the WCD guidelines, it did not succeed in fully capturing the criteria set out in the WCD. The shortcomings of the implementation documents can probably at least partially be explained by the process that was used to develop the current guidelines and template. The process that led to the adoption of the EU's WCD guidelines and compliance report template was informal and notably lacked transparency and public consultation.⁴⁵ For example, neither the European Parliament nor direct representatives of dam-affected peoples were involved (Scott 2011).

In order to avoid or minimize harm of such complex projects as hydropower, the WCD requires that planning and implementation processes be based on effective and fair stakeholder involvement, participatory decision-making and accountability. The EU evaluation is a one-time, ex-post check to make sure that the process was carried out in a satisfactory manner. Ensuring WCD requirements have been met ex-post is difficult given the complexity of the processes, and the subjectivity involved with assessing whether the WCD strategic principles were met in a meaningful way. In the following section we suggest concrete improvements in EU's assessment of WCD compliance.

5.3 DISCUSSION OF THE EU WCD EVALUATION REQUIREMENTS

5.3.1 Independent evaluation of WCD criteria is needed

The WCD report requires that projects be appraised by auditors that are institutionally and financially independent from the project developers. The EU guidelines require that the project developer hire and pay a Designated Operational Entity (DOE) to conduct the assessment (Scott 2011, Herz and Schneider 2008). This process is also used under the UNFCCC for the validation and verification of CDM projects. An inherent conflict of interest exists when those performing or verifying project assessments are hired directly by those with vested interests in the projects going forward. The lack of independence of these auditors has been criticized as one of the fundamental flaws of the CDM process (see for example, Schneider 2009 and Schneider and Mohr 2010). In informal conversations with the authors, project developers freely admitted that it is quite simple to get a WCD validation from a DOE. Also in our interviews and e-mail exchanges with European DNAs, we did not find a single instance where a project was rejected by a DNA because of an insufficient WCD evaluation.

The independence of the verifier is especially important if the assessment being made involves subjective judgments, as does the WCD evaluation. For example, while the WCD requires stakeholder participation at all stages of project development, evaluating the quality of that involvement can be quite subjective. The public consultation requirement can be deemed fulfilled even if community members were not properly informed of the impacts of the projects or given the opportunity to meaningfully express their opinions, or if opinions received are ignored when project design decision are made.

⁴⁵ There were no formal rules of procedure and no minutes of the various meetings were kept. The main actors included the European Commission and representatives from the Member States. A number of stakeholders were invited to participate, yet aside from 2 NGOs (International Rivers and WWF) these stakeholders were limited to carbon market participants, (project developers and consultants).

Recommendations on improving independent verification

- The designated national authority (DNA) of the buyer country, or another government agency, rather than the project developer, should choose WCD auditors. Project developers should be charged a fee that covers the costs of those audits and the oversight tasks of the government agency.
- The quality of WCD verification reports should be reviewed carefully. Future verifier hiring decisions should be based on whether previous assessments were performed rigorously and conservatively.
- Verifier performance should be evaluated periodically during a process of re-accreditation.
- The accreditation and re-accreditation processes should involve conflict of interest assessments.

5.3.2 Improving stakeholder involvement and evaluation of stakeholder involvement

Public consultations are difficult to conduct effectively even when those conducting them have the best of intentions of creating a participatory and informed decision-making process. Consultations are especially difficult to conduct effectively when there are power imbalances among members of the affected communities. Those who are more powerful often can more forcefully or effectively express their opinions (Mosse 1995, Rosenberg 2001) and the consultation leader must work to ensure a range of voices are heard.

Sound and thorough stakeholder involvement is especially important for hydro projects with their potential to cause serious harm to local ecosystems and communities. The WCD emphasizes that throughout project planning and implementation project-affected people must have the opportunity to actively participate in the decision-making process. Where projects affect indigenous and tribal peoples, decision-making processes must be ‘guided by their free, prior and informed consent’ (WCD 2000). The EU compliance report template asks project developers to report on a variety of issues involving the participation of stakeholders in the decision-making process, but it falls short of requiring that project developers demonstrate the acceptance of key decisions by them. The template for example asks: *Were compensation and benefit agreements planned in consultation with affected groups?* And: *Were the affected people satisfied with the compensation packages?* But the template does not require that compensation packages had to be mutually agreed with all recognized adversely affected people, but had merely to be planned ‘in consultation’ with affected people. Furthermore, the report template does not require proof of ‘free, prior and informed consent’ from indigenous or tribal peoples.

The stakeholder process under the UNFCCC has long been criticized for being inadequate. To address and potentially improve guidance and requirements for stakeholder involvement, the CDM Executive Board recently launched a public call for inputs on how stakeholder consultations could be improved. Nevertheless the CDM Executive Board has continued registering projects that were implicated in creating significant harm; for example the Board recently registered a project that has been linked with serious human rights abuses (Bajo Aguan #3197⁴⁶) and several other projects that have been criticized for inadequate stakeholder

⁴⁶ <http://cdm.unfccc.int/Projects/DB/TUEV-SUED1260202521.42/view> Also see: <http://www.fian.org/news/press-releases/united-nations-under-pressure-to-denounce-human-rights-abuses-in-carbon-offsetting-scheme>

consultations in the face of stiff local opposition to the project (for example Barro Blanco #3237,⁴⁷ and Rampur hydro-electric project #4568⁴⁸).

It seems that the EU should be legally required to guarantee transparency and public participation: The EU has ratified the UN/ECE Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention). The Aarhus Convention is a multilateral environmental agreement that grants the public rights regarding access to information, public participation in decision making and access to justice.⁴⁹ Yet the EU's harmonized procedures for approval of hydro projects do not specify clear mechanisms for the public to participate in credit application decisions, as required by the Aarhus Convention.

Recommendations on improving stakeholder involvement

More detailed requirements on how to conduct and verify stakeholder consultations and how to resolve contentious issues are especially important because WCD compliance assessments involve subjective judgments. The guidelines for carrying out and auditing stakeholder consultations prepared by the Gold Standard⁵⁰ (GS) could serve as a template for examining whether stakeholder involvement has been adequate. The GS guidelines require two stakeholder consultations. The first meeting is similar to what the UNFCCC requires, but much more guidance for organizing the meeting and content to be covered during the meeting is provided by GS. The second meeting is an opportunity for stakeholders to give feedback on how their comments were incorporated. The developer is required to submit a report detailing the outcome of the stakeholder consultations. The Gold Standard furthermore requires a "No Harm" assessment, guided by the UNDP Millennium Development Goals. Human rights, labor standards, environmental protection, and anti-corruption are assessed. The project developer is required to assess the risk of breaching 11 safeguarding principles and identify mitigation measures. For example, respect of rights of indigenous people and no involuntary settlement are principles listed under for the human rights category.

- Verifiers should receive additional guidelines and requirements on how to assess stakeholder involvement. These could be modeled and expanded based on Gold Standard processes and requirements.

⁴⁷ <http://cdm.unfccc.int/Projects/DB/AENOR1261468057.59/view> Also see unsolicited letter by CDM Watch to the CDM Executive Board: http://www.cdm-watch.org/wordpress/wp-content/uploads/2011/02/Unsolicited-letter_Barro-Blanco-PA-3237_March-2011.pdf.

⁴⁸ <http://cdm.unfccc.int/Projects/DB/BVQI1299859361.8/view> For more information see: <http://www.internationalrivers.org/node/1428>

⁴⁹ Article 1 of the Convention states:

In order to contribute to the protection of the right of every person of present and future generations to live in an environment adequate to his or her health and well-being, each Party shall guarantee the rights of access to information, public participation in decision-making, and access to justice in environmental matters in accordance with the provisions of this Convention.

Access to information: any citizen should have the right to get a wide and easy access to environmental information. Public authorities must provide all the information required and collect and disseminate them and in a timely and transparent manner.

Public participation in decision making: the public must be informed over all the relevant projects and it has to have the chance to participate during the decision-making and legislative process.

Access to justice: the public has the right to judicial or administrative recourse procedures in case a Party violates or fails to adhere to environmental law and the convention's principles. (Rodenhoff 2003).

- The EU should require formal agreements regarding compensation and rehabilitation plans and the distribution of benefits from the dam between the project developer and project-affected persons in order to demonstrate acceptance of key decisions.
- The EU should require the proof of free, prior and informed consent of indigenous people.

5.3.3 Improving access to compliance reports

According to the guidance document, ‘Members States are to provide publicly accessible information on projects that have been approved as fulfilling the requirements of Article 11(b)(6) as well as indicating the entities accepted to carry out a validation of the Compliance Report in each Member State.’

We found that Member States interpret this requirement quite differently. While some, such as Germany, make all the WCD compliance reports available on their website,⁵¹ others such as Sweden, France, the UK, Spain and the Netherlands do not. Sweden for example stated “The principle of public access does not mean that all documents are available online, but made available on request.” (e-mail communication with Swedish Energy Agency).

Recommendations on access to compliance reports

The lack of web-access to the compliance reports makes it difficult for stakeholders in host countries to get information needed to evaluate if a project has been sufficiently assessed. This could easily be remedied by requiring DNAs to make all the compliance reports available online.

- The transparency rules should be further harmonized: Member states should be required to provide online access to compliance reports and other relevant project information.

5.3.4 Requiring all hydropower projects comply with WCD criteria

Currently only hydropower projects over 20 MW are required by the EU to meet WCD standards. As discussed earlier, the distinction based on size of installed capacity is not adequate to filter out projects that cause substantial environmental and social harm. Furthermore smaller projects are subjected to fewer regulations and scrutiny in India and China, which represent over 70% of all small hydropower projects in the CDM pipeline (CDM/UNEP Risoe 1. Sept. 2011) and is likely to be the case for other countries as well. In China, small hydropower plants (< 50 MW) can be approved at the prefectural or provincial level, rather than the national level (Kibler 2011), resulting in fewer checks. While large projects in India are granted clearance from the Central Government and required an Environmental and Social Impact Assessment, small projects are not required to conduct such an assessment except under special conditions (MOEF 2006).

Recommendation on extending criteria

- Small hydropower projects providing credits to the EU should also comply with WCD requirements and procedures.

⁵¹ <https://www.jicdm.dehst.de/promechg/pages/project1.aspx>

6 CONCLUSIONS

This paper evaluated the additionality of hydropower projects in the CDM and sustainability criteria applied to these projects. Hydropower makes up 30% of all registered CDM projects and is expected to deliver close to a quarter of all CERs by 2020 (UNEP Risoe CDM/JI Pipeline Analysis and Database, 1 September 2011). Our analysis shows that the CDM's *Additionality Tool* is not effective at filtering out non-additional hydropower projects. We also find weaknesses in the EU's assessment of compliance with WCD guidelines. In the following conclusions we summarize the policy changes we recommend in order to ensure that CDM credits from hydropower projects have a high likelihood of being additional and of avoiding substantial adverse social and environmental impacts.

Large hydropower should be excluded from the CDM in all countries because it is unlikely to be additional and additionality testing is ineffective. Hydropower is already a conventional technology that is being built in large quantities worldwide without carbon credits. India and China, the two countries with most hydropower CDM projects, have aggressive targets for utilizing their hydropower resources in attempts to meet soaring power demand and to address energy security concerns related to growing dependence in both countries on imported coal. The interest in building large hydropower in both countries supersedes the relatively small effect CERs have on hydropower project financial return.

Furthermore additionality testing through the assessment of financial return is not a good predictor of whether a large hydropower project will be built because non-financial factors have a large influence on decisions to develop these projects. Uncertainty in investment analysis inputs allows project developers to choose input values strategically in order to show that their projects are less financially viable than they really are.

Small hydropower projects should only be allowed under the CDM where they are not already being built or are being built at much slower rates than they would with carbon credits, and in countries in which the governments are less able to financially support the technology. Small hydropower typically benefits from less political backing than large hydropower and so is more likely to involve private developer, making financial return more predictive of the development decision. However, the investment analysis is unreliable for small hydropower projects for the same reason it is unreliable for large hydropower – because of uncertainty in input values. Small hydropower is already being built in some countries at substantial rates and therefore would not pass the common practice test. In countries where there already is development of small hydropower projects, such as in China and India with supportive subsidies and tariffs, allowing small hydropower project to register under the CDM means potentially allowing a substantial portion of non-additional projects to register. Instead, types of small hydropower, defined by their size and location, and perhaps other objective characteristics, should be used to identify projects that are not currently being built, but which could be effectively enabled by the help of carbon credits. The effects of the CDM should be evaluated over time and should be clearly discernible for those projects types to continue to be eligible for crediting.

The common practice assessment should be strengthened. Our assessment of how the common practice test is being applied to hydropower projects shows that the definition of what constitutes common practice needs to be more stringent. Projects under construction and projects

in the CDM pipeline should be included in the common practice assessment for technologies such as hydropower that are already being built without the CDM. If a technology is deemed to be common practice through the common practice assessment, a proposed CDM project of that technology type should also be considered common practice; the ability to argue that a project is “essentially distinct” from other similar projects can easily be abused and should therefore be removed as an option under the common practice test.

Large and small CDM hydropower projects seeking to sell their CERs in the European Union should fulfill World Commission on Dams (WCD) sustainability criteria. Since hydropower projects of all sizes and types can have substantial, and sometimes severe, negative social and environmental impacts, all hydropower projects should be evaluated for their social and environmental impacts. Further, small hydropower is usually subject to fewer regulations and scrutiny than large hydropower. It would therefore be prudent that the EU’s WCD criteria be expanded to include hydropower projects below 20 MW.

The EU’s assessment of WCD compliance should be further strengthened. The EU’s efforts to operationalize the WCD guidelines are commendable but current rules and procedures do not fully capture the criteria set out in the WCD. Shortcomings include auditor conflicts of interest, weak guidance for the assessment of public consultations, and insufficient access to compliance reports by the general public. The current EU WCD requirements could be strengthened as follows:

- The designated national authority (DNA) of the buyer country, or another government agency, rather than the project developer, should choose WCD auditors. Project developers should be charged a fee that covers the costs of those audits and the oversight tasks of the government agency.
- The quality of WCD verification reports should be reviewed carefully. Future auditor hiring decisions should be based on whether previous assessments were performed rigorously and conservatively.
- Auditor performance should be evaluated periodically during a process of re-accreditation.
- The accreditation and re-accreditation processes should involve conflict of interest assessments.
- Auditors should receive additional guidelines and requirements on how to assess stakeholder involvement. These could be modeled and expanded based on Gold Standard processes and requirements.
- The EU should require formal agreements regarding compensation and rehabilitation plans and the distribution of benefits from the dam between the project developer and project-affected persons in order to demonstrate acceptance of key decisions.
- The EU should require the proof of free, prior and informed consent of indigenous people.
- EU member states should be required to provide online access to compliance reports and other relevant project information.
- All hydropower projects, large and small, should be required to meet WCD criteria.

Over 1000 hydropower projects are already registered under the CDM and another 700 are applying for registration. The consequences of registering non-additional projects and those with substantial adverse environmental and social impacts undermine climate mitigation goals by actually increasing emissions and placing the costs of climate change mitigation on communities most vulnerable to the impacts of climate change. Excluding large and some small hydropower

projects from the CDM and strengthening WCD compliance evaluations are important steps the European Union could take to strengthen the integrity of its climate mitigation goals.

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REFERENCES

- Aleem, A. (1972). Effect of river outflow management on marine life, *Journal of Marine Biology*, 15, 200-208.
- Amodovar, A. and Nicola, G. (1999). Effects of a small hydropower station upon brown trout *Salmo trutta* L. in the River Hoz Seca (Tagus basin, Spain) one year after regulation, *Regulated Rivers, Research and Management* 15(5), 477-484.
- Anderson, E. et al. (2006). Ecological consequences of hydropower development in Central America: Impacts of small dams and water diversion of neotropical stream fish assemblages, *Rivers Research and Applications*, 22, 397-411.
- Barros, N. et al. (2011). Carbon emission from hydroelectric reservoirs linked to reservoir age and latitude, *Nature Geoscience*, 4.
- Bartolome and Danklmaier (1999). Contributing Paper for WCD Thematic Review I.3 Displacement.
- Bartolome, L. et al. (2000). WCD Thematic Review I.3 Displacement, resettlement, rehabilitation, reparation and development.
- Behura and Nayak (1993). Involuntary displacement and the changing frontiers of kinship: A study of resettlement in Orissa, In Cernea, M. and Guggenheim, S. eds. *Anthropological Approaches to Resettlement: Policy, Practice, Theory*, Westview Press, Boulder.
- Bogner, M. and Schneider, L. (2011) "Is the CDM Changing Investment Trends in Developing Countries or Crediting Business-as-Usual? A Case Study on the Power Sector in China", in *Improving the Clean Development Mechanism - Options and Challenges Post-2012*, edited by Michael Mehling, Amy Merrill and Karl Upston-Hooper. Berlin: Lexxion.
- Bosshard, P. (2008). China's Environmental Footprint in Africa. *China in Africa Policy Briefing* (3)
- Boyd, E. et al. (2009). Reforming the CDM for sustainable development: lessons learned and policy futures, *Environmental Science and Policy* (12), 820-831.
- Caspary, G. (2007). The impacts of development-induced displacement on human security, *Human Security Journal*, 4, 70-81.
- CDM Executive Board. (2009). Guidelines on the Assessment of the Investment Analysis. EB 51 Report Annex 58. Copenhagen.
- CDM Executive Board. (2008). Guidelines for Completing the Project Design Document (CDM-PDD) and the Proposed New Baseline and Monitoring Methodologies (CDM-NM).
- Central Electricity Authority. (2008). *Hydro Development Plan for 12th Five Year Plan (2012-2017)*, New Delhi.

- Central Electricity Regulatory Commission. (2009). (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations. New Delhi.
- Cernea, M. (1999). *The Economics of Involuntary Resettlement: Questions and Challenges*, World Bank, Washington, D.C.
- Cernea, M. (2000). Risks, Safeguards, and Reconstruction: A Model for Population Displacement and Resettlement, In Cernea, M. and McDowell, C. eds. *Risks and Reconstruction: Resettlers' and Refugees' Experiences*, World Bank, Washington D.C., USA.
- Chambers, R. (1995). Paradigm shifts and the practice of participatory research and development. In *Power and Participatory Development: Theory and Practice*, ed. N Nelson, Susan Wright. London: ITDG Publishing
- Drinkwater, K. and Frank, K. (1994). Effects of river regulation and diversion on marine fish and invertebrates, *Aquatic Conservation: Marine and Freshwater Ecosystems*, 4(2), 135-151.
- Egré, D. and Milewski, J.C. (2002). The diversity of hydropower projects, *Energy Policy*, 30(14), 1225-1230.
- Englund, G. and Malmqvist, B. (1996). Effects of flow regulation, habitat area and isolation on the macroinvertebrate fauna of rapids in North Swedish rivers, *Regulated Rivers*, 12, 433-445.
- European Small Hydro Association (2010). Available at: www.esha.be/index.pjp?id=13
- European Union (2004). Directive 2004/101/EC Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:338:0018:0023:EN:PDF>
- European Union (2008a). Guidelines on a common understanding of Article 11b (6) of Directive 2003/87/EC as amended by Directive 2004/101/EC (non-paper) Available at http://ec.europa.eu/clima/policies/ets/linking/ji-cdm/docs/art11b6_guide_en.pdf
- European Union (2008b). Compliance Report Assessing Application Of Article 11 B (6) Of Emissions Trading Directive To Hydroelectric Project Activities Exceeding 20 MW (Final Version of 17 November 2008) Available at http://ec.europa.eu/clima/policies/ets/linking/ji-cdm/docs/art11b6_comp_temp_en.pdf
- Fearnside, P. (2004). Greenhouse gas emissions from hydroelectric dams: Controversies provide a springboard for rethinking a supposedly “clean“ energy source – An editorial comment, *Climatic Change*, 66, 1-2.
- Fernandes, W. and Paranjpye, V. (1997). Hundred Years of Displacement in India: Is the Rehabilitation Policy an Adequate Response? In Walter Fernandes and Vijay Paranjpye (eds) *Rehabilitation Policy and Law in India: A Right to Livelihood*, 1-34, Indian Social Institute, New Delhi, India.
- Giles, J. (2006). Methane quashes green credentials of hydropower, *Nature*, 444, 524-525.
- GS (2009). Gold Standard Toolkit. Available at: <http://www.cdmgoldstandard.org/Current-GS-Rules.102.0.html>
- Hægstad Flåm K. (2007). A Multi-level Analysis of the EU Linking Directive Process The Controversial Connection between EU and Global Climate Policy. Fridtjof Nansen Institute. Available: <http://www.fni.no/doc&pdf/FNI-R0807.pdf>
- Haya, B., (under preparation) Can the CDM's investment analysis accurately test additionality? A focused look at wind power, biomass energy and hydropower projects in India

- He, G., Morse, R.K. (2010). *Making Carbon Offsets Work in the Developing World: Lessons from the Chinese Wind Controversy*, Program on Energy and Sustainable Development, Stanford University, Palo Alto.
- Herz S. and Schneider AK. (2008). International Rivers' Comments on the Non-paper on a Common Understanding of Article 11b (6) of Directive 2003/87/EC as amended by Directive 2004/101/EC and the Draft Compliance Report Assessing Implementation of Article 11b(6) to Hydro-electric Projects Exceeding 20 MW. International Rivers. Available at: <http://www.internationalrivers.org/files/International%20Rivers%27%20comments.pdf>
- IJHD (2010). World Atlas and Industry Guide, International Journal of Hydropower and Dams, Wallington Surrey, UK.
- Institute for Global Environmental Strategies (IGES). (2011). IGES CDM Project Database. Japan: 1 September 2011
- International Energy Agency. (2007). *World Energy Outlook 2007: China and India Insights*, Paris
- Irving, J. and Bain, M. (1993). Assessing cumulative impacts on fish and wildlife in the Salmon River, Idaho, In S. Hildebrand and J. Cannon, *The Scientific Challenges of NEPA: Future directions based on 20 years of experience*, 357-372, Lewis Publishers, Boca Raton, USA.
- Jiandong, T. (2009). Some Features of China's Small Hydropower. *Hydro Nepal* (4)
- Kahrl, F., Williams, J., Jianhua, D., Junfeng, H. (2011). Challenges to China's transition to a low carbon electricity system. *Energy Policy* (39): 4032-41
- Kemenes, A. et al. (2011). CO₂ emissions from a tropical hydroelectric reservoir (Balbina, Brazil), *Journal of Geophysical Research*, 116.
- Kibler, K. (2011). *Development and Decommission of Small Dams: Analysis of Impact and Context*, Ph.d. Dissertation, Oregon State University.
- Koenig, D. and Diarra, T. (2000). The effects of resettlement on access to common property resources, In Cernea, M and McDowell, C. eds. *Risks and Reconstruction: Resettlers' and Refugees' Experiences*, World Bank, Washington, D.C.
- Kubecka, J. et al. (1997). Adverse ecological effects of small hydropower stations in the Czech Republic: 1 bypass plants, *Regulated Rivers Research and Management*, 13, 101-113.
- Kumar, A. et al. (2011). Hydropower. In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation* [O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, C. von Stechow (eds)], Cambridge University Press, Cambridge and New York. Available at: <http://srren.ipcc-wg3.de/report>.
- Lazarus, M. and Chandler, C. (2011). *Coal Power in the CDM: Issues and Options*. Stockholm Environment Institute, Seattle.
- Magee, D., McDonald, K. (2009). Beyond Three Gorges: Nu River Hydropower and Energy Decision Politics in China. *Asian Geographer* 1-2(25): 39-60
- Mahmood, K. (1987). Reservoir sedimentation: Impact, extent and mitigation, Technical Paper No. 71, World Bank, Washington, DC
- Mäkinen, K. and Khan, S. (2010). Policy considerations for greenhouse gas emissions from freshwater reservoirs, *Water Alternatives*, 3.
- McCully, P. (2001). *Silenced Rivers: The Ecology and Politics of Large Dams*. Zed Books, London.

- McCully, P. (2008). The Great Offset Swindle, in ed. Pottinger, *Bad Deal for the Planet, Dams, River and People Report 2008*, International Rivers, Berkeley. Available at <http://www.internationalrivers.org/climate-change/bad-deal-planet-why-carbon-offsets-arent-workingand-how-create-a-fair-global-climate->
- Michaelowa, A., Purohit, P. (2007). Additionality determination of Indian CDM projects: Can Indian CDM project developers outwit the CDM Executive Board?, Climate Strategies, Zurich.
- Ministry of New and Renewable Resources (2009). *Small Hydro Power Programme (up to 25 MW Capacity)*. No. 14 (1)/2008-SHP. New Dlehi
- Ministry of Water Resources in People's Republic of China (2002). Small Hydropower Station Design Specifications, Ref. No. GB50071-2002, Beijing.
- MOEF- Ministry of Environment and Forests (2006). Environmental Impact Assessment Notification, Ministry of Environment and Forests, Government of India.
- Mosse, D. (1995). Local Institutions and power: The history and practice of community management of tank irrigation systems in south India. In *Power and Participatory Development: Theory and Practice*, ed. N Nelson, Susan Wright. London: ITDG Publishing.
- Natural Resources Canada (2009). Available at: http://canmetenergy-canmetenergie.nrcan-ncan.gc.ca/eng/renewables/small_hydropower.html
- Naughton, B. (2007). *The Chinese Economy: Transitions and Growth*. MIT Press, Cambridge.
- NDRC. (2007). *Medium and Long Term Plan for Renewable Energy Development in China*. Beijing
- Neeraj, V. and Das, P. (2010). *Damming Northeast India*, Kalpavriksh, Pune, India. Available at: <http://www.kalpavriksh.org/media-articles-and-press-releases>
- Office of the Compliance Advisor/Ombudsman of the International Finance Coroporate (2005). *Assessment Report: Complaint regarding Allain Duhangan Hydro Power Project*
- Pandey, B. (1998). *Depriving the underprivileged by development*, Institute for Socio-Economic Development, Bhubaneshwar, India.
- Planning Commission of the Government of India. (2006). *Integrated Energy Policy*, New Delhi, http://planningcommission.nic.in/reports/genrep/rep_intengy.pdf
- Planning Commission of the Government of India. (2008). *Eleventh Five Year Plan (2007-2012)*, New Delhi
- Raghunath, H. (2009). *Hydrology: principles, analysis, and design*, New Age International, New Delhi.
- Revenga, C. et al. (2000). *Pilot analysis of global ecosystems: Freshwater ecosystems*, World Resources Institute, Washington, D.C.
- Rodenhoff, V. (2003). "The Aarhus convention and its implications for the 'Institutions' of the European Community". *Review of European Community and International Environmental Law* 11 (3): 343–357.
- Rosenberg, J., F.L. Korsmo. (2001). Local participation, international politics, and the environment: The World Bank and the Grenada Dove. *Journal of Environmental Management* (62): 283-300
- Schneider, L. (2007). *Is the CDM fulfilling its environmental and sustainable development objectives? An evaluation of the CDM and options for improvement*, Report Prepared for WWF, Öko-institut e.V., Berlin.

- Schneider, L. (2009). A rating of Designated Operational Entities (DOEs) Accredited under the Clean Development Mechanism (CDM). Oeko Institute. Available at: <http://oeko.info/oekodoc/902/2009-020-en.pdf>
- Schneider, L. (2009). Assessing the additionality of CDM projects: practical experiences and lessons learned. *Climate Policy* (9): 242–54
- Schneider L. and Mohr L. (2010). 2010 Rating of Designated Operational Entities (DOEs) accredited under the Clean Development Mechanism (CDM). Oeko Institute.
- Scott, J. (2011). In Legal Limbo: Post-Legislative Guidance as a Challenge for European Administrative Law. *Common Market Law Review*, Vol. 48, No. 2, 2011. Available at SSRN: <http://ssrn.com/abstract=1783557>
- Scudder, T. (2005). *The Future of Large Dams: Dealing with Social, Environmental and Political Costs*. Earthscan, London.
- Soumis, N. et al. (2005). Hydroelectric reservoirs as anthropogenic sources of greenhouse gases, In Lehr J. and Keeley, J. *Water Encyclopedia Volume 3: Surface and agricultural water*, 203-210, J. Wiley and Sons, Hoboken.
- Stewart, J. et al. (1996). *A People Dammed: The Impact of the World Bank Chixoy Hydroelectric Project in Guatemala, Witness for Peace*.
- St. Louis, V. et al. (2000). Reservoir surfaces as sources of greenhouse gases: A global estimate, *Bioscience*, 50(9), 766-775.
- Thomas, M. (1998). Biocontrol: Risky but necessary? *Trends in Ecology and Evolution*, 13, 325-328.
- UN/ECE Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (1998). Available at <http://www.unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf>
- UN (2009). Observaciones sobre la situación de la Comunidad Charco la Pava y otras comunidades afectadas por el Proyecto Hidroeléctrico Chan 75 (Panama). Available at: <http://www.culturalsurvival.org/news/panama/un-special-rapporteur-issues-report-panama-dam>
- UNEP RISOE Pipeline Analysis and Database August 1st, September 1st, October 1st 2011. Available at: <http://cdmpipeline.org/>
- Wara, M.W., Victor, D.G. (2008). *A realistic policy on international carbon offsets. Rep. PESD Working Paper #74*, Program on Energy and Sustainable Development, Stanford University, Palo Alto.
- World Bank (1999). Identifying opportunities to address malaria through infrastructure projects, Workshop Report. Available at: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTHEALTHNUTRITIONANDPOPULATION/EXTMALARIA/0,,contentMDK:20370190~menuPK:377618~pagePK:210058~piPK:210062~theSitePK:377598~isCURL:Y,00.html>
- World Commission on Dams (WCD). (2000). *Dams and Development: a New Framework for Decision-Making*. Available at: http://www.dams.org/index.php?option=com_content&view=article&id=49&Itemid=29
- WCD (2000a). Thematic Review I.2 Indigenous People. Available at: www.adb.org/water/topics/dams/pdf/tr12main.pdf
- WCD (2000b). Thematic Review I.3 Displacement. Available at: <http://siteresources.worldbank.org/INTINVRES/Resources/DisplaceResettleRehabilitationReparati onDevFinalI3main.pdf>